

(12)

**EUROPEAN PATENT APPLICATION**

(21) Application number: 85303155.7

(51) Int. Cl.<sup>4</sup>: H 04 N 7/173

(22) Date of filing: 03.05.85

(30) Priority: 31.05.84 US 615957  
31.05.84 US 616412  
31.05.84 US 616411

(43) Date of publication of application:  
08.01.86 Bulletin 86/2

(84) Designated Contracting States:  
AT BE CH DE FR GB IT LI LU NL SE

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(54) Cable television system.

(57) A cable television system and method in which each subscriber's converter is located outside the subscriber's premises in an external control unit ("ECU") which also includes several other subscribers' converters. The ECU includes common signal processing circuitry for controlling all the converters in the ECU. In addition to television signals, the cable network transmits control and data signals in both directions between the ECU and the head end of the system and between the ECU and each subscriber. Each subscriber supplies a portion of the power required by the associated ECU. Multiple television channels can be supplied to each subscriber via a single drop cable connecting the subscriber to the ECU.

EP 0 167 237 A2

SECRET

0167237

ATC 1004-1006

### CABLE TELEVISION SYSTEM

#### Background of the Invention

This invention relates to cable television systems, and more particularly to cable television systems in which the converter for converting portions of the television signal on the cable network to the television signal which is applied to the subscriber's television receiver is located outside the subscriber's premises.

There is increasing interest in cable television systems in which the converter for converting the portion of the cable television signal which the subscriber desires to receive to a signal suitable for application to the subscriber's television set is located outside the subscriber's premises, for example, on or adjacent to a neighboring utility or telephone pole. This is of interest because it reduces the risk of unauthorized tampering with the converter, accidental or intentional misappropriation of or damage to the converter, and the like.

On the other hand, locating the converter outside the subscriber's premises increases the complexity and cost of the system because apparatus must then be included in the system to enable the subscriber to remotely control the converter. This consideration has tended to discourage the develop-

ment of cable television systems with off-premises converters.

It is therefore an object of this invention to improve, simplify and reduce the cost of cable television systems with off-premises converters.

#### Summary of the Invention

This and other objects of the invention are accomplished in accordance with the principles of the invention by providing a cable television system and method in which the off-premises converters of several adjacent subscribers are at least partially controlled by common signal processing circuitry associated with those converters. The common signal processing circuitry and all the associated converters are preferably located in a common facility, for example, a housing mounted on or adjacent to a utility pole neighboring the premises of the associated subscribers. This apparatus is referred to herein as an external control unit or "ECU". The ECU preferably includes only a single tap for each network cable serving the ECU. The signals derived from this tap are distributed appropriately to the components of the ECU. A drop cable extends from the ECU to each subscriber's premises.

Inside the subscriber's premises the drop cable is connected to a subscriber processing unit or "SPU" which is typically located adjacent to the subscriber's television receiver. The SPU applies the television signal on the drop cable to the television receiver and also applies subscriber-originated control signals to the drop cable for transmission back to the ECU. Other devices located in the subscriber's premises, such as burglar, fire and other alarm or monitoring equipment capable of applying control signals to the drop cable for transmission

back to the ECU, can also be connected to the drop cable.

The ECU processes the control signals originated by all of the associated subscribers to satisfy, if appropriate, the service requests indicated by those control signals. In particular, the common signal processing circuitry in the ECU is used as extensively as possible to process the subscriber-originated control signals to minimize the amount of separate ECU circuitry which must be provided for each subscriber.

The ECU is also capable of receiving and responding to control signals from the so-called "head end" of the cable network. For example, these control signals may include channel authorization data identifying which channels on the cable network a particular subscriber is authorized to receive and view. These head-end-originated control signals are preferably transmitted via the cable network, and the common signal processing circuitry in each ECU is again used as extensively as possible to process these signals. Because each ECU typically serves several subscribers, all of those subscribers can be serviced from the head end by control signals addressed to the ECU rather than to each subscriber individually. This greatly facilitates control of the system from the head end.

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawing and the following detailed description of the invention.

#### Brief Description of the Drawing

Figure 1 is a block diagram of a cable television system constructed in accordance with the invention.



Figure 2 is a schematic diagram of a typical subscriber unit ("SU") in the apparatus of Figure 1.

Figure 3 is a block diagram of the analog unit in the apparatus of Figure 1.

Figure 4 is a schematic block diagram of the communication unit in the apparatus of Figure 1.

Figures 5a-5i, which are connected together as shown in Figure 5j, are collectively a schematic block diagram of the digital unit in the apparatus of Figure 1. Figures 5k-5s are collectively a schematic diagram of the gate array shown in Figure 5c. Figures 5a-5s are sometimes collectively referred to as Figure 5.

Figure 6 is a schematic diagram of the common power unit in the apparatus of Figure 1.

Figure 7 is a schematic block diagram of the "SPU" in the apparatus of Figure 1.

Figure 8 is a block diagram of the central control computer ("CCC") and modem of the headend in the apparatus of Figure 1.

Figures 9a-b are flow charts illustrating the flow of a program controlling the operation of the so-called Drop Processor of the ECU.

Figures 10a-b are diagrams of basic message formats used in an embodiment of the invention for data communication in the forward direction from the CCC to an ECU.

Figure 11 is a diagram of a basic message format used in an embodiment of the invention for data communication in the reverse direction from an ECU to the CCC.

Figures 12-17 are diagrams of various messages sent between the CCC and an ECU in an embodiment of the invention.

Figures 18a-h are flow charts illustrating the flow of a program controlling the operations of

the so-called Data Processor of the ECU in an embodiment of the invention.

Figure 19 is a diagram of a basic message format used in another embodiment of the invention for data communication in the forward direction from the CCC to an ECU.

Figure 20 is a diagram of a basic message format used in another embodiment of the invention for data communication in the reverse direction from an ECU to the CCC.

Figures 21a-23d are diagrams of messages sent between the CCC and an ECU in another embodiment of the invention.

#### Detailed Description of the Invention

##### 1. Overview of the System

As shown in Figure 1, an illustrative embodiment of the cable television system 10 of this invention includes head end apparatus 12; cable network 14; a plurality of external control units ECU1, ECU2, etc., connected to cable network 14 at locations which are typically remote from one another and from head end 12; and a plurality of subscriber premises SUB1, SUB2, etc., each of which is connected to an associated ECU by a drop cable DROP1, DROP2, etc. In the particular embodiment shown in the drawing, each ECU can be connected to as many as six subscribers, but this number is arbitrary and the maximum number of subscribers per ECU can be larger or smaller than six as desired.

Head end 12 typically includes one or more sources of television signal information such as conventional satellite antenna 20. Conventional satellite receiver 22 separates the television signal information received via antenna 20 into a plurality of base band television signals, each of which represents one base band television channel.

Conventional modulator 24 modulates each of these television signals so that each base band channel is shifted to a predetermined frequency or "physical" cable channel for distribution via cable network 14. Additional base band television and other signals (e.g., television signals from studio cameras or video recorders, FM audio signals, etc.) may also be applied to modulator 24 via leads 26, 28, etc., and shifted to predetermined physical cable channels by the modulator.

All of the output signals of modulator 24 are applied to conventional combiner 30 which combines them for application to cable network 14 via conventional combiner 32. Combiner 32 also adds control and data signals to the signal applied to cable network 14. These control and data signals may be of two types: (1) a so-called "forward data" signal which represents information generated at head end 12 for controlling the ECUs in the network, and (2) a forward high data rate channel ("HDRC") signal which is typically included in the FM band and which allows the cable network to be used for such purposes as distributing non-television signal data (e.g., general purpose computer programs and data) to the subscribers. Because the forward HDRC signal is typically included in the FM band, the term "FM audio signal" as used herein includes the forward HDRC signal if such a signal is employed in the system.

In addition to adding forward data and forward HDRC signals to the signal applied to cable network 14, combiner 32 also conducts so-called "reverse data" signals in the opposite direction from cable network 14 to modem 34. The reverse data signals are control signals generated by the ECUs as described below for transmission to head end 12 for use in controlling the cable television network. In

the illustrative embodiment shown and described herein, four channels are available for reverse data communication. Modem 34 converts (modulates) forward data signals produced by central control computer ("CCC") 36 to signals suitable for transmission via cable network 14. Modem 34 also converts (demodulates) reverse data signals received from cable network 14 to signals suitable for processing by central control computer 36.

Combiner 32 also extracts from the signal on cable network 14 a reverse HDRC signal which allows the cable network to be used for such purposes as transmitting non-television signal data (e.g., fire and burglary alarm signals) from the subscribers to a central location such as head end 12. The reverse HDRC signal is typically in a frequency band (e.g., 25 MHz) which is independent from all other frequency bands employed in the system. The use of a reverse HDRC frequency band in the present invention enables direct two-way communication between the head end and the subscribers, and minimizes noise and other signal degradation problems affecting other communication signals on the CATV cable and inherent in conventional two-way CATV systems.

Each ECU includes a conventional tap off device 50 for applying the signals which appear on cable network 14 to the circuitry of the ECU and for applying to cable network 14 the reverse data originating at the ECU and the reverse HDRC signals originating at the associated subscribers. Each ECU is typically located outside the premises of the subscribers served by the ECU. Typically, all the circuitry of the ECU is located in a common housing which may be adapted for mounting on a utility pole or other suitable structure adjacent to the premises of the subscribers served by the ECU.

Tap off device 50 is connected to conventional splitter-combiner network 52. Splitter-combiner network 52 distributes the signals received from cable network 14 to a plurality of subscriber units SU1, SU2, etc. within the ECU, each of which is associated with a respective one of the subscribers served by the ECU. Although each SU includes additional apparatus described in detail below, for the moment it will be sufficient to think of each SU as a digitally controlled converter for performing the television signal frequency conversion function performed by the converter located adjacent the subscriber's television receiver in conventional cable network systems.

Splitter-combiner network 52 also distributes the signals received from cable network 14 to analog unit 54, described in greater detail below. In general, analog unit 54 separates the FM audio and forward data signals from the other signals received from cable network 14. Analog unit 54 applies the FM audio signal to each SU for transmission to the subscribers. Analog unit 54 also demodulates the forward data signal and applies the resulting data signal to digital unit 55. Analog unit 54 applies reverse HDRC signals received from the SUs to splitter-combiner network 52, and splitter-combiner network 52 applies those reverse HDRC signals to tap off device 50 and thereby to cable network 14.

Splitter-combiner network 52 also applies reverse data signals from communication unit 56 to tap off device 50. In addition, if a so-called "slave" ECU (not shown in Figure 1) is associated with "master" ECU1 as described in detail below, splitter-combiner network 52 conveys signals in both directions via lead 58 between tap off device 50 and the splitter-combiner network of the slave ECU.

As mentioned above, each SU receives the entire cable network signal from splitter-combiner network 52. In response to control signals received from digital unit 55, each SU (1) selects from the cable network signal the portion of that signal representing the television channel which the associated subscriber wishes to view, and (2) converts that signal portion to a television signal on a predetermined channel (e.g., channel 3) to which the associated subscriber's television receiver 90 is tuned. This television signal is applied to the SU's associated drop cable DROP1, DROP2, etc., which runs from the SU to the associated subscriber's premises SUB1, SUB2, etc. Each SU also receives the FM audio signal from analog unit 54 and combines that signal with the television signal applied to the associated subscriber's drop cable.

The ECU communicates via each SU with the associated subscriber's apparatus (in particular, the SPU of the associated subscriber) by means of so-called very low frequency ("VLF") data signals on the associated drop cable. Also, when a subscriber operates his or her SPU to make a television channel selection, the SPU applies to the associated drop cable for transmission to the ECU VLF data signals representative of the desired channel selection. Each SU conveys these VLF data signals in both directions between the associated subscriber drop cable and communication unit 56 which includes a modem for conveying these VLF data signals to and from digital unit 55. Each SU also conveys reverse HDRC signals from the associated subscriber drop cable to analog unit 54.

The power required to operate each ECU is supplied by the subscribers served by that ECU. Each subscriber has an SPU which applies an alternating current ("AC") power signal to the associated

drop cable. The associated SU conveys that power signal to common power unit 60 in the ECU. Common power unit 60 combines all of the applied power signals and derives from the combined signal the currents and voltages needed to power the various components of the ECU. In this way, all of the subscribers served by the ECU share the power requirements of the ECU. In the event of a general AC power failure, common power unit 60 applies a control signal to digital unit 55 which causes the digital unit to shut down in such a way that important data is not lost.

Digital unit 55 controls the operation of the ECU. Digital unit 55 receives and processes forward data applied to the digital unit via analog unit 54. Digital unit 55 also generates reverse data and applies that data to communication unit 56 for transmission to head end 12. Digital unit 55 receives and processes demodulated VLF signals applied to the digital unit via communication unit 56 from all of the SUs in the ECU. Digital unit 55 also generates other signals for transmission back to the subscribers via communication unit 56 and the SUs. Digital unit 55 also controls various functions of the SUs. For example, when a subscriber wishes to view a particular television channel, digital unit 55 receives VLF signals generated by the subscriber indicating the desired channel selection, determines whether or not the subscriber is authorized to receive that channel based upon channel authorization data previously provided by head end 12, and, if the subscriber is authorized to receive the desired channel, controls the subscriber's SU to cause it to apply the desired channel signal to the subscriber's drop cable.

Each subscriber has at least one SPU, at least one conventional television receiver 90 con-

nected to the SPU, and (optionally) a conventional remote control unit ("RCU") for remotely controlling the SPU by infrared or other signals. The SPU is connected to the drop cable and applies the received drop cable signal to the associated television receiver 90. The received drop cable signal may also be applied to the subscriber's (optional) FM audio receiver equipment (not shown) and to the subscriber's (optional) forward HDRC utilization equipment (also not shown). The SPU has a conventional keypad (not shown in Figure 1) for allowing the subscriber to enter data such as the number of the television channel the subscriber wishes to receive. Alternatively, this data can be entered via the subscriber's RCU. The SPU converts data entered by the subscriber to VLF data signals which are transmitted to the associated ECU via the subscriber's drop cable. The SPU also typically has data display elements such as seven-segment light emitting diode ("LED") displays. These displays can be controlled by VLF data sent to the SPU from the associated ECU. The SPU also applies the reverse HDRC signal originated by the subscriber to the associated drop cable.

The following Table A summarizes the allocation of carrier signal frequencies in the illustrative embodiment of the invention shown and described herein:



TABLE A

<u>Type of Signal</u>	<u>Approximate Frequency</u>
1. AC Power	60 Hz
2. VLF Data (ECU to SPU)	430 KHz
3. VLF Data (SPU to ECU)	468 KHz
4. Reverse Data	
a. Channel 0	19.125 MHz
b. Channel 1	19.375 MHz
c. Channel 2	19.625 MHz
d. Channel 3	19.875 MHz
5. Reverse HDRC Data	25 MHz
6. Television	50-88 MHz 108-450 MHz
7. FM Audio (Includes Forward HDRC Data)	88-108 MHz
8. Forward Data	104 MHz

It will be understood that the frequencies shown in Table A are merely illustrative and that other frequencies can be employed if desired. For convenience herein, the television and FM audio signals on cable network 14 (items 6 and 7 in Table A, above) are sometimes hereafter referred to collectively as CATV signals.

Although cable network 14 has only a single feeder cable in the embodiment shown in Figure 1, two feeder cables can be employed if desired to increase the number of television channels available for distribution to subscribers. For example, if two cables were provided, elements such as 24, 30, 32, 50, and 52 would be substantially duplicated to serve the second cable. Each SU would receive input CATV signals from each cable. To select between the

two cables, each SU would also include a switch controlled by digital unit 55 for switching between the two applied cable signals. This is discussed in greater detail below in relation to the SUs. In a multi-cable system, the FM audio, reverse HDRC, forward data, and reverse data signals are preferably transmitted by only one cable, designated the primary cable, thereby allowing some simplification of the apparatus associated with the other cable or cables. Thus, elements such as 34, 36, 54, 55, 56, and 60 do not have to be duplicated or even significantly altered to provide a multi-cable system.

It is also possible for each subscriber to have more than one television receiver 90. The additional television receiver or receivers can be attached to one SPU, in which case all of the television receivers receive the same television signal. Alternatively, the additional television receiver or receivers can be served by a second SPU to enable the subscriber to simultaneously select and receive two different television channels. If a subscriber has two SPUs, both of the SPUs can be connected to a single drop cable. In such a case, one SPU will be configured as a "master" SPU, and the other will be configured as a "slave" SPU. At the ECU, a subscriber with a master and slave SPU is served by two SUs. Each SU is associated with a different SPU. The signals from both SUs are multiplexed onto the single drop cable. The television signal from the first or "primary" SU is converted by the SU to, and applied to the drop cable as, a first or lower drop cable channel. The television signal from the other or "secondary" SU is converted to, and applied to the drop cable as, a second or higher drop cable channel. The television receiver associated with each SPU is tuned to a respective one of the two drop cable channels.

Thus, each subscriber has at least one primary SU in the ECU associated with a master SPU. If a subscriber has two SPUs, that subscriber may also have a secondary SU in the ECU associated with the slave SPU. In any event, the total number of SUs which can be included in an ECU in the particular embodiment shown and described herein is six.

If additional subscriber service is needed at the location of an ECU which is operating at capacity, then a second or "slave" ECU containing six more SUs can be connected to the splitter-combiner network 52 of the "master" ECU via lead 58 as mentioned above. In this way, additional subscriber service can be provided without the necessity of cutting into the cable network 14 to insert an additional tap 50.

## II. Subscriber Unit

Figure 2 shows a typical subscriber unit SU1 in greater detail. The cable network signal from splitter-combiner network 52 (Figure 1) is applied to conventional converter tuner 100 via the INPUT terminal and optional switching device 102. If the system had two cables rather than one as shown in Figure 1, each SU would have two INPUT terminals, each connected to a respective one of the two cables. Switching device 102, which can include a conventional RF switching relay such as part number G4Y-152P available from Tateishi Electric Co. ("Omron") of Tokyo, Japan, would then be used to apply one or the other of the two cable signals to converter tuner 100. Switching device 102 would be controlled to select signals from one or the other CATV feeder cable by a conventional transistor switch (part of switching device 102) responsive to the state of the Q3 output on pin 7 of conventional addressable latch 140.

Converter tuner 100, together with conventional frequency synthesizer 104 and the circuits including crystal 106, capacitors 108, 110, 112, 114, 116, 118, 120, resistors 122, 124, 126, 128, and transistors 130 and 132, selects the portion of the cable television signal which the associated subscriber wishes to receive, converts that signal portion to a television signal on the channel to which the subscriber's television receiver 90 is tuned, and applies that signal to the DROP CABLE output terminal of the SU via conventional FM adder device 180, directional coupler 182, and capacitor 184. In one embodiment, converter tuner 100 may be part number CVA 213A (channel 3) or CVA 215A (channel 5) available from Toshiba Corporation of Tokyo, Japan (hereinafter "Toshiba"), or an equivalent device to convert the CATV signals to the same or other channels or frequencies. Frequency synthesizer 104 may be Toshiba part number TD6352P or an equivalent device.

The converter circuitry operates as follows. Via its DATA input lead, frequency synthesizer 104 receives a ten-bit main channel conversion coefficient ("MCCC") and a five-bit "swallow" conversion coefficient ("SCC"). The bits of these two coefficients, which are sometimes collectively referred to as the main and swallow ("MS") coefficients, are shifted into frequency synthesizer 104 at the clock rate established by its CLOCK input. When all the bits of the MS coefficients have been shifted into frequency synthesizer 104, they are latched into the synthesizer in response to a signal applied to the LOAD input terminal. Frequency synthesizer 104 then uses the MS coefficients in a known manner to (1) scale down the frequency of the voltage controlled LOCAL OSCILLATOR ("LOC. OSC.") output signal of converter tuner 100, (2) perform a phase

detection comparison between the scaled down LOC. OSC. signal frequency and the reference OSCILLATOR ("OSC.") signal frequency provided in part by crystal 106, and (3) produce an error signal at the PHASE DETECTOR OUTPUT ("P/D OUT") terminal. The error signal produced by frequency synthesizer 104 is used to control the voltage controlled oscillator in converter tuner 100 to cause that oscillator to produce the demodulation signal frequency needed to convert the desired cable channel to the channel to which the subscriber's television receiver 90 is tuned.

Addressable latch 140, which may be Toshiba part number TC40H259 or an equivalent device, receives control and data signals from digital unit 55, stores that data, and outputs it to frequency synthesizer 104. In particular, addressable latch 140 receives data via its DATA input lead and processes that data in accordance with the function control signals applied to its A, B, and C input leads. The addressable latch in a particular SU is selected and thereby enabled by an appropriate signal applied to the NOT ENABLE ("NEA") input terminal of the addressable latch to be selected. (In general, the logical polarity of signals and signal names appearing in the drawings will be ignored in this specification. Thus, for example, whereas the signal at pin 14 of addressable latch 140 is actually an inverse enable signal, that signal is simply referred to in this specification by its functional name "NEA" without regard for its logical polarity.) Resistors 142-147 are pull-up resistors conventionally associated with selected inputs and outputs of addressable latch 140.

Addressable latch 140 also monitors whether or not the associated subscriber is supplying his or her share of the AC power needed to operate the ECU. This function is performed in response to the

signal applied to the CLEAR ("CL") input terminal of addressable latch 140. If the associated subscriber is not providing AC power to the ECU via the subscriber's drop cable, the Q4 output signal of addressable latch 140 controls the circuit including resistors 150-152, transistors 153-155, diode 156, inductor 158, and capacitor 159 to shut off power to associated converter tuner 100. This prevents any subscriber who is not supplying AC power to the ECU from receiving television signals from the ECU. The Q5 output signal of addressable latch 140 also indicates whether or not the associated subscriber is supplying AC power. This Q5 output signal is applied to the POWER DETECT output terminal of the SU for use by digital unit 55.

Each primary SU such as SU1 has a power section which includes filtering inductor 160, diodes 161-163, capacitors 164-167, and resistors 168-169. Inductor 160 blocks VLF and CATV signals. Diodes 161 and 162 respectively produce half-wave rectified power signals ("+" and "-") from a 60 volt or less AC power signal on the associated drop cable. The + and - signals are respectively connected to and summed with other + and - power signals from other subscribers and SUs (i.e., SU2-SU6) in the ECU. The summed power signals then are applied to common power unit 60 which is described in detail below. Circuit elements 163 and 167-169 constitute another half-wave rectifier circuit which produces a DC output signal (which is clamped to approximately +5V by diode 157) as long as the associated subscriber is supplying AC power via the drop cable. This DC output signal is applied to the CL input terminal of addressable latch 140 via voltage dividing resistors 170-171 for the purpose described above.

If a secondary SU (e.g., SU2) is associated with SU1 to enable the subscriber to select and

receive two multiplexed channels via the drop cable, then the DC output signal produced by elements 163 and 167-169 is also applied to the secondary SU via resistor 172 in the primary SU and jumper 173 in the secondary SU. Jumper 173 is a completed connection only in the secondary SU. Power supply elements 160-169 are omitted from the secondary SU, as is capacitor 184. Also in the secondary SU, the terminal corresponding to the DROP CABLE terminal in Figure 2 is connected to the FM INPUT AND REVERSE HDRC OUTPUT terminal of the associated primary SU. Thus, the secondary SU selects one television channel, adds the FM signal to the first television channel signal, and applies the resulting signal to the FM INPUT AND REVERSE HDRC OUTPUT terminal of the associated primary SU. The primary SU selects the second television channel, adds that signal to the signal received from the secondary SU, and applies the resulting signal to the subscriber's drop cable. In this way each subscriber can receive as many as two television channels multiplexed on a single drop cable. As mentioned above, each of the subscriber's television receivers is tuned to view one or the other of the two channels on the drop cable. The only other differences between the primary and secondary SUs are (1) the use of different local oscillator frequencies so that the primary and secondary SUs place the selected cable channels on different drop cable channels, and (2) the omission in the secondary SU of what would otherwise be a redundant VLF input/output.

The remaining elements in the SU are (1) a power filtering circuit including inductor 190 to block high-frequency signals from entering the +27V power line, and capacitor 192 and resistor 194 to remove high-frequency ripple from the +27V power

line, and (2) capacitor 196 which is connected between the VLF input/output lead and ground. Directional coupler 182 conveys VLF signals in both directions between the drop cable and the VLF input/output terminal.

### III. Analog Unit

As shown in Figure 3, analog unit 54 includes bandpass filter 200 for extracting the FM audio (approximately 88-108 MHz) and forward data (104 MHz plus or minus 100 KHz) signals from the CABLE SIGNAL. The FM signal is applied to each of the FM OUTPUT AND REVERSE HDRC INPUT terminals of analog unit 54 via input/output coupling network 202. Each FM OUTPUT AND REVERSE INPUT HDRC terminal of analog unit 54 is connected to the FM INPUT AND REVERSE HDRC OUTPUT terminal of a respective one of the SUs.

Input/output coupling network 202, bandpass filter 204, and lowpass filter 206 convey reverse HDRC signals (25 MHz plus or minus .5 MHz) from the FM OUTPUT AND REVERSE HDRC INPUT terminals to the CABLE SIGNAL terminal. Thus, filters 204 and 206 allow reverse HDRC signals to pass from subscriber premises SUB1, SUB2, etc. (Figure 1) through the ECU and directly to cable network 14, thereby providing a data signal path for direct communication via cable network 14 between the subscribers and head end 12. However, filters 204 and 206 block other signals from directly passing from the subscribers and drop cables to cable network 14. In particular, filters 204 and 206 prevent signals, such as citizen band and other two-way radio signals, from entering cable network 14 and interfering with or degrading the reverse data signals sent from the ECUs to head end 12. In contrast, in a conventional two-way cable



television system, such interfering signals typically are picked up at various poorly or loosely connected or dirty or corroded drop cable connections and cracked cable shields in the CATV system. The use of an HDRC channel and elements 204 and 206 in the CATV system of the present invention thus allows for reliable, high-speed, direct two-way communication between subscribers and head end 12 by isolating cable network 14, and the reverse data transmitted thereon, from interfering signals picked up by numerous drop cable connections.

Conventional bandpass filter 210 extracts the forward data signal from the output signal of bandpass filter 200. The forward data output signal of bandpass filter 210 is applied to mixer 212 for mixing with the 108.5 MHz output signal of local oscillator 214. The resulting 4.5 MHz output signal is amplified by conventional intermediate frequency amplifier 216 and applied to conventional detector 220. Detector 220 converts the frequency-modulated ("FM") forward data signal to a base band forward data signal which is applied to the FORWARD DATA OUTPUT terminal of analog unit 54 for application to digital unit 55.

#### IV. Communication Unit

Figure 4 shows communication unit 56 in greater detail. Communication unit 56 is controlled by digital unit 55 and facilitates communication of (1) reverse data from the ECU to the CCC of head end 12, and (2) VLF data to and from the ECU and each associated subscriber's SPU.

For communicating information from the ECU to head end 12, communication unit 56 includes reverse channel selector 300, conventional modulator 330, and conventional bandpass filter 332. Channel

selector 300, on command from digital unit 55, selects any one of four available reverse channels for transmission of ECU reverse data to head end 12. A two-bit reverse channel selection signal ("REV. CH. A" and "REV. CH. B") is applied from digital unit 55 to conventional binary decoder 302. Depending on the bit combination present on the A and B inputs of decoder 302 (i.e., 00, 01, 10, or 11), one of the four outputs of decoder 302 will be low and all other outputs will be high. The outputs of decoder 302, each of which is connected to a respective one of four crystal-controlled oscillators 304, 306, 308, and 310, in turn cause one of the four oscillators to be operative. Each oscillator 304, 306, 308, and 310 is tuned to oscillate at a different frequency corresponding to one of the frequencies of the four channels available for reverse data communication. In one embodiment, oscillators 304, 306, 308, and 310 operate at 19.125 MHz, 19.375 MHz, 19.625 MHz, and 19.875 MHz, respectively. It will, of course, be appreciated that other frequencies and a different number of reverse channels can be used if desired.

The output of the particular oscillator selected by decoder 302 is applied to modulator 330 as a carrier frequency for modulation by the reverse data to be transmitted to head end 12. Modulator 330 can be any conventional modulator for modulating digital signals onto an analog carrier. In a preferred embodiment, modulator 330 is a binary phase-shift keyed ("BPSK") modulator, such as part number MC 1496 available from Motorola Corporation of Phoenix, Arizona (hereinafter "Motorola"). Data is modulated for transmission on each reverse channel at a data rate of 50 Kbps.

Channel selector 300 also includes conventional logic circuit 305 (comprised, for example, of

conventional NOR and NAND gates) for receiving and enabling the transmission of digital reverse data from digital unit 55 to head end 12, and for receiving a request-to-send ("RTS") signal from and providing a clear-to-send ("CTS") signal to digital unit 55. If digital unit 55 is not sending data to head end 12, digital unit 55 maintains the RTS lead to logic circuit 305 in a logical "0" state. This causes logic circuit 305 to apply a signal to transistor 309 through current-limiting resistor 307, thus shorting the output of oscillators 304, 306, 308, and 310 to ground and preventing the application of carrier to modulator 330. In addition, logic circuit 305 (1) maintains the CTS lead in a logical "1" state, thus signaling to digital unit 55 that it is not clear to send data, and (2) disables transmission of data signals to modulator 330. If digital unit 55 desires to send data to head end 12, it raises the RTS lead. This causes logic circuit 305, after a short delay, to (1) remove the signal from transistor 309 to allow a carrier signal to be applied to modulator 330, (2) present a logical "0" state on the CTS lead to signal digital unit 55 that it is clear to send data, and (3) enable the passage of data signals to modulator 330. Digital unit 55 may transmit data only while CTS is in a logical "0" state.

Modulator 330 modulates the reverse data presented at its data input line onto the carrier signal presented at its carrier input line. The output of modulator 330 is a modulated signal having a selected one of four carrier frequencies which is applied to bandpass filter 332. Bandpass filter 332 has a 1 MHz passband centered at 19.5 MHz. The output of bandpass filter 332 is reverse channel output, which is applied to splitter-combiner network

52 (Figure 1) for transmission via cable network 14 to head end 12.

For enabling communications between the ECU and each associated subscriber SUB1, SUB2 ... etc., communication unit 56 includes bi-directional multiplexer 350 for connecting a first input/output line to any one of a plurality of second input/output lines as a function of a binary code appearing on subscriber address lines A, B, and C. Subscriber address lines A, B, and C are connected to digital unit 55 to enable digital unit 55 to selectively connect any one of the plurality of second input/output lines to the first input/output line. In a preferred embodiment, multiplexer 350 is a 1-to-8 multiplexer, such as Toshiba part number TC4051BP, having 8 second input/output lines, only 6 of which are used (one for each of up to six SUs). Each of the second input/output lines is connected to the VLF input/output terminal of a respective one of subscriber units SU1, SU2 ... etc. (see Figure 2). By presenting different code combinations on address lines A, B, and C (i.e., 000, 001, 010, 011, 100, or 101), digital unit 55 can select a particular drop cable to enable a particular subscriber to communicate with the ECU.

For receiving communications from subscribers, the first input/output line of multiplexer 350 is connected through DC-blocking capacitor 336 to the input of very low frequency ("VLF") demodulator 340. VLF demodulator 340 receives VLF-modulated analog signals transmitted from the SPUs at a data rate of 1200 bps (or any other convenient rate) and demodulates those signals into serial digital data for processing by digital unit 55. In one embodiment, the VLF signals received from the SPUs are

on/off amplitude-shift keyed ("ASK") modulated signals having a carrier frequency of 468 KHz. A logical "1" (mark) is represented by 100% carrier, and a logical "0" (space) is represented by 0% carrier. Demodulator 340 includes a conventional parallel tuned LC circuit 342 tuned to produce an output in response to the receipt at its input of a signal having a frequency of 468 KHz. The output of circuit 342 is applied to surface acoustic wave ("saw") filter 344 also tuned to 468 KHz. The output of saw filter 344 in turn is connected to conventional amplifier 346 which produces a mark and space data output in response to the presence and absence of carrier. This data output is applied to digital unit 55 for processing as data received from the SPUs.

For communication from the ECU to the SPUs, data from digital unit 55 is applied to the data input connection of VLF modulator 320. In one embodiment, VLF modulator 320 modulates digital data signals at a data rate of 1200 bps (or any other convenient rate) from digital unit 55 into an on/off ASK analog VLF signal having a carrier frequency of 430 KHz. Data from digital unit 55 turns on and off transistor 327 (via current-limiting resistor 328). Transistor 327 in turn controls on and off FET transistor switch 324 via resistors 325 and 326. The 430 KHz carrier signal produced by conventional crystal-controlled oscillator 322 is applied to the base of transistor 360 which is connected in such a way that the carrier signal appears at the transistor's collector shifted 180° relative to the carrier signal appearing at the transistor's emitter. The collector carrier signal is switched on and off by transistor switch 324 in accordance with the VLF data to be transmitted to an SPU. This switched

carrier signal is applied to the first input/output line of multiplexer 350 via resistor 334 for transmission to one of the plurality of subscriber SPUs. The continuous carrier signal appearing at the emitter of transistor 360 is applied to all of the second input/output lines of multiplexer 350 via transistor 370 and resistors 381-386. In this way, there is constant 430 KHz carrier on all of the second input/output lines of multiplexer 350 except when the carrier on one of those lines is cancelled by the switched carrier from transistor switch 324.

#### V. Digital Unit

As shown in Figure 5, digital unit 55 has two major subparts. Those subparts are (1) signal processing portion 55a (shown in Figures 5a-5f), and (2) memory portion 55b (shown in Figures 5g-5i). These two portions of digital unit 55 are interconnected by means of the terminals represented by rectangles and numbered 01-40. For example, the terminal numbered 01 in Figure 5f is connected to the correspondingly numbered terminal in Figure 5g.

Digital unit 55 includes conventional universal synchronous or asynchronous receiver/transmitter ("USART") 400, such as part number 8274 available from Intel Corporation of Santa Clara, California (hereinafter "Intel"). USART 400 converts HDLC-formatted serial forward data received from head end 12 into parallel data for processing by the remainder of digital unit 55. USART 400 also converts parallel reverse data generated by other elements in digital unit 55 into HDLC-formatted serial data for transmission back to head end 12. The operation of USART 400 is augmented by gate array 402, shown in detail in Figures 5k-5s, which performs various functions such as converting non-return to zero inverted ("NRZI") forward data from

head end 12 on the FORWARD DATA lead to non-return to zero ("NRZ") "receive" data on the RXD lead. Gate array 402 also converts NRZ "transmit" data on the TXD lead to NRZI reverse data on the REVERSE DATA lead.

USART 400 and gate array 402 are also interconnected by INTERRUPT ("INT"), CLOCK ("CLK"), RXC, TXC, READ ("RD"), WRITE ("WR"), and RESET ("RES") leads. The INT signal is generated by USART 400, is inverted by gate array 402, and is applied to the INT0 terminal of microprocessor 420. This signal is used to alert microprocessor 420 to the occurrence of an important event in USART 400 (e.g., the fact that a character has been received or transmitted via the FORWARD or REVERSE DATA leads). The CLK3 output signal of gate array 402 is derived from the CLKOUT output signal of microprocessor 420. In particular, the 6MHz CLKOUT signal is divided by two by gate array 402 to produce the 3MHz CLK3 output signal which is applied to USART 400. The RXC output signal of gate array 402 is a clock signal derived by gate array 402 from the NRZI forward data signal. The TXC input signal of gate array 402 is a clock signal produced by microprocessor 420 to control the rate at which reverse data is transmitted back to head end 12. The source of the RD and WR signals is microprocessor 420. These signals respectively cause other devices in digital unit 55 to output data so that microprocessor 420 can read it, or cause other devices in digital unit 55 to input data from microprocessor 420. The ultimate source of the RESET or RES signals is power detect circuit 480. The POWER DETECT input terminal of digital unit 55 is connected to the RESET output terminal of common power unit 60 (Figure 6). Power detect circuit 480 produces an output signal for

resetting microprocessor 420 when power is restored following a power outage. Microprocessor 420 responds to this RES input signal by producing a RESET output signal which is applied to the RESET input terminal of gate array 402. Gate array 402 applies an inverted RESET signal to USART 400, microcomputer 450, and hex inverting buffer 465.

Gate array 402 is shown in detail in Figures 5k-5s. In Figure 5k, reference number 250 denotes a typical input buffer; reference number 252 denotes a typical AND gate; reference number 254 denotes a typical NAND gate; reference number 256 denotes a typical J-K flip-flop; reference number 258 denotes a typical D-type flip-flop; reference number 260 denotes a typical OR gate; and reference number 262 denotes a typical output buffer. In Figure 5s, reference number 264 denotes a typical latch. The following Table B correlates the gate array 102 pin numbers shown in Figure 5c with the lead labels used in Figures 5K-5s:



TABLE B

<u>Figure 5c</u> <u>Pin Number</u>	<u>Lead Label in</u> <u>Figures 5k-5s</u>
1	IN1
2	REST
3	IN10
4	IN3
5	IN4
6	IN5
7	IN6
8	IN7
9	IN8
10	IN9
11	IN11
12	IN12
13	---
14	GND
15	IN13
16	OT10
17	OT9
18	OT8
19	OT7
20	OT6
21	OT5
22	OT4
23	OT3
24	OT2
25	OT1
26	OT12
27	OT11
28	VCC

In addition, leads with EX labels in Figures 5k-5s are connected to similarly labelled leads in Figures 5k-5s. For example, the output lead labelled EX4 in Figure 5m is connected to the input lead labelled EX4 in Figure 5l. The detailed operation of the gate array circuits shown in Figures 5k-5s will be readily apparent to those skilled in the art from the circuits themselves and from the preceding and following functional description of gate array 402 in relation to the other components of digital unit 55.

USART 400 has a REQUEST TO SEND ("RTS" or "DTRA") lead by which it interrogates communication

unit 56 to ensure that the communication unit is ready to transmit reverse data to head end 12. If communication unit 56 is ready to transmit reverse data, the communication unit sends an appropriate signal to USART 400 on the CLEAR TO SEND ("CTS" or "CTSA") lead. USART 400 selects the reverse data channel to be used by means of signals on the REVERSE DATA CHANNEL SELECT A and B ("RTSA" and "RTSB") leads, which are also connected to communication unit 56.

Pull-up resistor networks 404-407 are connected in the conventional way between +5V power supply circuit 414 and the CTS, RTSA, RTSB, RTS, INTERRUPT, FORWARD DATA, and REVERSE DATA leads, as well as to the TXDB and RXDB leads which are not used. Power supply circuit 414 is configured conventionally to provide noise protection for the +5V power signal used throughout digital unit 55. The VCC terminal of USART 400 is also conventionally connected to +5V power supply 414 in parallel with capacitors 408 and 409. The VCC terminal of gate array 402 is similarly connected to the +5V power supply in parallel with capacitors 410 and 411. The SYNCA terminal of USART 400 is clamped to the +5V supply via resistor 412. The PRI, CDA, and GROUND ("GND") leads of USART 400 and the GROUND ("GND") lead of gate array 402 are all connected to ground.

USART 400 applies parallel forward data to the data bus of digital unit 55 via terminals D0-D7. USART 400 also receives parallel reverse data from the data bus via terminals D0-D7. The data bus distributes data among USART 400, microprocessor 420, latches 430 and 432, multiplexers 440 and 442, microcomputer 450, and memory unit 475. Pull-up resistor network 413 is connected in the conventional way between the +5V power supply and the data bus leads.

Microprocessor 420, which can be a conventional microprocessor such as Intel part number 80186, performs such functions as (1) communicating with head end 12, (2) processing subscriber requests (e.g., channel selection), and (3) communicating with microcomputer 450. In addition to the data bus connections, microprocessor 420 communicates with USART 400 via its DRQ1, INTA0, DRQ0, A1, A2, PCS0, T1OUT, and T0OUT leads. When USART 400 is to read data directly from the memory portion 55b of digital unit 55, USART 400 requests direct memory access ("DMA") for reading by applying a DRQ1 signal to microprocessor 420. Microprocessor 420 acknowledges receipt of an INT0 signal from USART 400 via gate array 402 as described above by means of an INTA0 output signal. When USART 400 is to write data directly to the memory portion 55b of digital unit 55, USART 400 requests direct memory access ("DMA") for writing by applying a DRQ0 signal to microprocessor 420. The A1 output signal of microprocessor 420 is applied to USART 400 to select one of two register sets in USART 400 for connection to the data bus. The A2 output signal of microprocessor 420 is applied to USART 400 to one of two register types (i.e., control "C" or data "D") within the USART register set selected by the A1 signal. The PCS0 (programmable chip select 0) output signal of microprocessor 420 is used to select USART 400 for reading data from (WR) or writing data to (RD) microprocessor 420. The T0OUT output signal of microprocessor 420 is a timer signal which controls the rate at which forward and reverse data are transmitted. The T1OUT output signal of microprocessor 420 is similar to the T0OUT signal, but controls the data rate on unused channel TXDB/RXDB.

Microprocessor 420 also communicates with gate array 402 via its T0OUT, PCS2, PCS4, BHE, INT0,

RESET, CLOCK OUT ("CLKOUT"), READ ("RD"), and WRITE ("WR") leads. The T0OUT output signal of microprocessor 420 is described above. The PCS2 and PCS4 (programmable chip select 2 and 4) output signals of microprocessor 420 are similar to the PCS0 signal described above. The BHE (byte high enable) output signal of microprocessor 420 is used to allow the 16-bit data bus to be used as an 8-bit data bus. The INT0 input signal of microprocessor 420 is described above in connection with USART 400 and gate array 402. The RESET, CLKOUT, RD, and WR output signals of microprocessor 420 are also described above.

Microprocessor 420 applies data and address signal information to the data bus and receives such information from the data bus via its AD0-AD15 leads. Microprocessor 420 communicates directly with microcomputer 450 via its INT1, INT3, and PCS1 leads. Microprocessor 420 applies additional control signals to memory unit 475 via its UPPER CHIP SELECT ("UCS"), MIDDLE CHIP SELECT ("MCS0"), and LOWER CHIP SELECT ("LCS") leads. The operating frequency of microprocessor 420 is established in the usual way by the circuit including crystal 421 and capacitors 422 and 423. The VCC, T0IN, T1IN, SRDY, and ARDY leads are connected to the +5V power supply in parallel with capacitors 424 and 425. The TEST, GROUND ("GND"), NMI, and HOLD leads are connected to ground. As mentioned above, the RES terminal of microprocessor 420 is connected via power detect circuit 480 (including resistors 481-486, inductor 487, transistors 488-489, Zener diode 490, diode 491, and capacitor 492) to the POWER DETECT input terminal of digital unit 55. The POWER DETECT terminal is connected the RESET output terminal of common power supply 60 and is used to

detect an AC power failure. When AC power is restored following a power interruption, power detect circuit 480 holds microprocessor 420 in the reset condition until sufficient time has elapsed to allow the microprocessor to re-initialize itself properly. For this purpose, the output signal of power detect circuit 480 is connected to the RESET ("RES") terminal of microprocessor 420 in parallel with capacitor 426.

Latches 430 and 432 are used to store address signal information produced by microprocessor 420 at terminals AD0-AD15 while associated data signals are transmitted or received via those same microprocessor terminals. The 1Q-8Q output leads of latches 430 and 432 collectively comprise an address bus which is connected to memory unit 475. Latches 430 and 432 are enabled by the ADDRESS LATCH ENABLE ("ALE") signal produced by microprocessor 420 and applied to the G input terminal of each latch. Power (+5V) is applied to the VCC input terminal of each latch 430 and 432 in parallel with capacitors 434-436. The OC terminals of both latches are connected to ground.

Multiplexers 440 and 442 act as an interface between 16 manually positioned switches 444, which specify the address of the ECU, and microprocessor 420 to enable the information represented by switches 444 to be read by the microprocessor in two successive 8-bit bytes. The signal for selecting ("SEL") multiplexers 440 and 442 comes from latch 432. The multiplexers are advanced or stepped by the signal applied to their OC terminals from gate array 402. Power (+5V) is supplied to the VCC terminals of multiplexers 440 and 442 in parallel with capacitors 445-447. Pull-up resistor networks 448-449 are conventionally connected between the +5V

power supply and the data input leads of the multiplexers.

Microcomputer 450, which can be a conventional microcomputer such as Intel part number 8472, performs such functions as (1) controlling communications with the subscribers via the drop cables, (2) controlling the tuner/converters in the SUs, and (3) communicating with microprocessor 420. Microcomputer 450 is connected to the data bus via its D0-D7 leads. The VDD, VCC, and SS leads of microcomputer 450 are connected to the +5V power supply in parallel with capacitors 451 and 452. The A0 lead is connected to the SEL input terminals of multiplexers 440 and 442. The P25, P24, and CS leads are connected directly to microprocessor 420 as mentioned above. The RESET, WRITE ("WR"), READ ("RD"), XTAL2, XTAL1, and T1 leads are connected to gate array 402. The RD lead is also connected to memory unit 55b. The signals on the XTAL1 and XTAL2 leads determine the operating frequency of microcomputer 450. Pull-up resistor network 453 is connected between these leads and the +5V power supply.

The P20-P23 and PROG terminals of microcomputer 450 are connected to conventional input/output expander 454 which may be Intel part number TMP82C43P. Expander 454 allows a small number of microcomputer input/output terminals to be connected to a larger number of input/output leads. The EA and VSS leads of microcomputer 450 are connected to ground. In a development configuration, the P17 lead of microcomputer 450 is connected via pull-up resistor 455 to the +5V power supply, and via manually operated switch 456 to ground.

Microcomputer 450 receives VLF data from communication unit 56 via its T0 lead. The P16 lead is not used. Six SUBSCRIBER SELECT signals are produced by microcomputer 450 and applied to leads

P10-P15. Each of these signals is applied to a respective one of the six SUs in this ECU in order to select the one or more of the SUs which is to respond to the DATA and FUNCTION SELECT signals mentioned below. The signals on leads T0 and P10-P16 pass through conventional buffering and pull-up resistor network 457, which is also connected to the +5V power supply.

The +5V power supply is connected to input/output expander 454 in parallel with capacitors 458 and 459. The CHIP SELECT ("CS") and GROUND ("GND") leads are connected to ground. The signal on lead P43 is serial DATA for use by the SU or SUs selected by the SUBSCRIBER SELECT output signals of microcomputer 450. For example, this DATA signal may be the MS coefficients used by the SUs as described above in relation to the SUs. The signals on leads P40-P42 are the three FUNCTION SELECT signals which are applied to the SUs to control their processing of the above-mentioned DATA signal. The signals on the P60-P63, P70, and P71 leads are respectively the six POWER DETECT signals produced by the SUs as described above. As mentioned above, each of these signals indicates whether or not the associated subscriber is supplying his or her share of the total AC power required for operation of the ECU. The signal on the P53 lead is the VLF data signal to be transmitted from the ECU to a selected subscriber's SPU via communication unit 56. The signals on the P50-P52 leads are also applied to communication unit 56 where they are used to control multiplexer 350 which selects the SPU that is to send or receive VLF data. The signals on leads P40-P43, P50-P53, P60-P63, and P70-P71 pass through conventional buffering and pull-up or clamping resistor network 460. Leads P72 and P73 are respectively connected to ground via manually operated

switches 461 and 462 and to the +5V power supply via pull-up resistor network 463. Switches 461 and 462 allow the ECUs in the system to be grouped in up to four different addressable banks.

Back-up power supply 464 operates during a total AC power failure to prevent loss of data in an essential portion of memory unit 55b, i.e., the portion of the memory unit selected by the LOWER CHIP SELECT ("LCS") signal. A back-up power supply includes conventional hex inverting buffer 465, resistors 466-469, capacitors 470-472, diode 473, and inductor 474. Buffer 465 may be Toshiba part number TC40H368P or an equivalent device. The back-up power is actually derived from capacitor 471 which is a relatively large storage capacitor. While the AC power is on, capacitor 471 is charged from the +5.7 volt power supply via the circuit including elements 468, 469, and 472-474. During an AC power interruption (as indicated by the reset signal applied to the 1A input terminal of buffer 465), capacitor 471 supplies +5V back-up power to energize buffer 465, to provide an LCS signal, and to provide +5V power to the portion of memory unit 475 selected by the LCS signal.

Memory unit 55b includes two conventional 16K-byte read only memories ("ROMs") 476 and 477 which store the operating program instructions for microprocessor 420. Each of ROMs 476 and 477 may be Intel part number 27128, or an equivalent device. Memory unit 55b also includes six conventional 8K-byte random access memories ("RAMs") 493-498 which store the data needed for control of the ECU. Each of RAMs 493-498 may be Toshiba part number TC5565PL-15 or an equivalent device. The connection of the various elements of memory unit 55b to the remainder of digital unit 55, as well as the



inter-connection of the memory unit elements, is entirely conventional and will be readily apparent to those skilled in the art. The UCS, MCS0, and LCS signals are used to extend the 16-bit address information to allow use of more memory than can be accessed using only 16 bits. The UPPER BANK SELECT ("BKU") and LOWER BANK SELECT ("BKL") signals produced by gate array 402 are used in combination with jumper network 478 to allow the relative amounts of ROM and RAM to be changed if desired. RAMs 495 and 496 are the memory unit elements energized by back-up power supply 464 in the event of an AC power outage as described above.

#### VI. Common Power Supply

To reduce the amount of power required to be supplied by the CATV system operator, the power required to operate each ECU is supplied by the subscribers served by that ECU. This is accomplished by having each master SPU apply a 60-volt AC power signal to the SPU's associated drop cable. As earlier described, the AC power signals from each subscriber are converted by each subscriber's associated SU into + and - half-wave rectified DC power signals. The + and - signals are respectively summed and applied to common power unit 60.

Figure 6 shows common power unit 60 in greater detail. As shown in Figure 6, the combined + and - power obtained from the SUs is applied to a filter/smoothing circuit 510. Filter/smoothing circuit 510 includes a plurality of filtering capacitors 514 and 516 to further remove AC ripple from the input power. A pair of series-inductances 512 remove any CATV or VLF communication signals still present with the power signal.

The output of filter/smoothing circuit 510 is a well-filtered but unregulated DC voltage.

This DC voltage output is applied to the input of a conventional switching power supply 520. Switching power supply 520 includes a step-down transformer 522 for producing as an output three AC power signals. These AC power signals are each half-wave rectified by rectifying diodes 532, 534, and 536, respectively. The outputs of diodes 532, 534, and 536 are smoothed and filtered by capacitances 543, 545, and 547 and inductances 542, 544, and 546. The outputs of the capacitance/inductance smoother/filter circuits are each applied as inputs to conventional voltage regulator circuits 530, 540, and 550, respectively. Voltage regulator circuits 530, 540, and 550 regulate the voltage appearing at their inputs to DC voltage levels of 27 volts, 12 volts, and 5 volts, respectively. These output voltages are each further filtered by output capacitors 570, 572, and 574. A fourth regulated output of 5.7 volts is obtained from the circuit comprising series-pass transistor 560, diode 562, and Zener diode 564. The output signal of inductor 546 is also used as a RESET signal for indicating an AC power failure. This RESET signal is applied to the POWER DETECT input terminal of digital unit 55 as described above.

The regulated DC output voltages of common power supply 60 are used to power the circuitry of the associated ECU. Thus, +5V, +12V, and +27V signals are applied from common power supply 60 to each subscriber unit (Figure 2), as well as to analog unit 54 (Figure 3), communication unit 56 (Figure 4), and digital unit 55 (Figure 5). To ensure that each subscriber equitably shares in providing power to operate the ECU associated with that subscriber, each SU includes power detection circuitry, earlier described, to turn the SU off in the event that AC

power is not being received from the drop cable associated with the SU.

#### VII. Subscriber Processing Unit

Subscriber processing units (SPUs) are located within subscriber residences. Each SPU is designed to (1) accept and transmit to its associated ECU subscriber-entered data, such as channel tuning requests, pay-per-view requests, parental control requests, and other functions normally associated with the television viewer, and (2) receive data and commands from the ECU to display information to a subscriber and control on and off the operation of the subscriber's television receiver. In addition, each SPU may serve as a data input terminal to accommodate audience response, shop-at-home, and other occasional two-way activities. Figure 7 shows a typical master SPU in detail.

As shown in Figure 7, a typical master SPU is connected via plug 761 to a source of subscriber-supplied 120-volt AC power. Transformer 762 steps down this power for use by the SPU. Conventional rectifier and smoothing network 760 rectifies the AC power for application to conventional voltage regulator circuit 764. Voltage regulator circuit 764 supplies as an output ("+") all necessary regulated DC voltages required to operate the circuitry of the SPU.

In addition to supplying AC power to rectifier/filter 760, transformer 762 provides as an output a source of 60 volt, 60 Hz AC power for application to the drop cable connecting the SPU to its associated ECU. For this purpose, transformer 762 includes a separate secondary winding connected to capacitor 761 and inductor 763. Inductor 763 presents a high impedance to the relatively high frequency CATV, VLF, and reverse HDRC signals, but

presepts a low impedance to the lower frequency AC power signals. AC power signals are tapped off from inductor 763 and applied to terminal 767 to which is connected the drop cable. Thus, each subscriber, via the master SPU in the subscriber's residence, provides a share of the total power required to operate the ECU to which the subscriber's SPU is connected. If the SPU of Figure 7 were a slave SPU, inductor 763 would be removed so that only the subscriber's master SPU would supply power to the drop cable.

Drop cable terminal 767 is also connected to one terminal of conventional directional coupler 778 through capacitor 765. Capacitor 765 presents a high impedance to 60 Hz AC power signals, but a low impedance to the higher frequency CATV, VLF, and reverse HDRC signals. Another terminal of directional coupler 778 is connected via combiner 779 to a terminal ("TV") to which the subscriber's television receiver 90 (Figure 1), optional FM audio receiver equipment, and optional forward HDRC utilization equipment are attached. In this way, CATV signals (including television, FM audio, and forward HDRC signals) received from the ECU are transmitted to the devices which utilize those signals. Combiner 779 adds the reverse HDRC signal for application to the drop cable. Although in the preferred embodiment, a subscriber's television, FM audio and HDRC equipment are connected to the drop cable via connection to the SPU, it will of course be appreciated that such equipment may instead be connected to the drop cable without direct connection to the SPU by utilizing a conventional directional coupler and capacitor. Thus, the present invention provides subscribers with great flexibility in variously locating the SPU and the subscribers'

television apparatus and other equipment within the subscribers' premises.

The terminal of directional coupler 778 connected to the TV and FM audio terminal is also connected to the input of conventional VLF demodulator 770. Demodulator 770 receives signals transmitted from the ECU, including CATV and VLF communication signals. As already described with respect to an embodiment of the ECU, ECU-to-SPU VLF communication signals are ASK-modulated signals having a carrier frequency of 430 KHz. This carrier signal is on continuously except when data is being transmitted. Demodulator 770 demodulates the applied ECU-to-SPU VLF signals to produce serial digital data as an output. This is accomplished in one embodiment by parallel tuned LC circuit 776 which is tuned to 430 KHz. Conventional amplifier/filter circuit 774, which in one embodiment uses a surface acoustic wave ("saw") filter as the filtering element, receives the output of circuit 776 to provide an output only when 430 KHz carrier is detected. The output from circuit 774 is then applied to operational amplifier 772 which produces an output that is high or low in response to the presence or absence, respectively, of a signal from amplifier/filter 774. Operational amplifier 772 thus produces a digital data output representative of the information transmitted to the SPU from the ECU via the VLF signal.

The digital data output of demodulator 770 is applied to a data input line and to an interrupt input line of conventional microcomputer 700. Microcomputer 700 may be any suitable commercially available microprocessor or microcomputer such as Toshiba part No. TMP 4740P, which is 4-bit microcomputer having 4k bytes of on-board ROM and 256 bytes of on-board RAM memory. An object and source code

computer program listing which will be readily understood by those skilled in the art suitable for controlling the operations of microcomputer 700 is annexed hereto at Appendix A.

Microcomputer 700 utilizes data received from the ECU to display information on conventional 7-segment display 710. In one embodiment, display 710 is capable of displaying two decimal digits representative, for example, of the television channel to which the associated SU in the ECU is tuned. Microcomputer 700 drives display 710 in a conventional manner by multiplexing display data onto a common seven-line bus B1 and alternately enabling two return lines A and B. Resistor-pack 712 includes seven resistors, each resistor being in series with a line of bus B1 to provide current limiting for display 710.

Microcomputer 700 also utilizes data received from the ECU to illuminate a so-called order event lamp. In one embodiment, the order event lamp is a conventional light emitting diode (LED) 790 connected to microcomputer 700 via current limiting resistor 792. As described in greater detail below, the order event lamp may be utilized to inform the subscriber that the subscriber is viewing a program for which the subscriber will be charged an additional fee.

Another circuit element controlled by microcomputer 700 is television power relay 791. Television power relay 791 is a normally-open relay which controls the application of 120-volt AC power to power outlet 793, into which the associated television receiver 90 is plugged. Relay 791 is controlled on and off on command from the ECU.

Also connected to microcomputer 700 is keyboard 720 for use by the subscriber, for example, in entering channel selection requests. In one em-

embodiment, keyboard 720 is a conventional membrane matrix keyboard having four columns and four rows. A common bus B2 having eight lines connects the keyboard's row and column outputs via resistor pack 722 to corresponding inputs of microcomputer 700. In addition to keyboard 720, an optional remote control unit ("RCU") may be used to enable a subscriber to remotely enter data into the SPU (see Figure 1). Such an RCU may be of any type, wired or not. In one embodiment, the RCU is a conventional wireless device which communicates with the SPU by transmitting coded infra-red light. In the SPU, conventional remote control receiver 730 having a photo-diode sensitive to infra-red light receives these coded signals and converts them into serial digital data. This data is then provided to microcomputer 700.

Microcomputer 700 communicates subscriber-entered channel and other requests to the attached ECU by sending digital data to VLF modulator 740. The digital data turns transistor 742 on and off via current-limiting resistor 783. In turn, transistor 742 turns on and off FET transistor 746 via resistors 743, 745, 747, and 749. FET transistor 746 controls on and off the output of continuously operating 468 KHz oscillator 744 to ASK modulate a 468 KHz signal. Saw filter 748 provides bandpass limiting for the modulated output of modulator 740. The output of saw filter 748 is applied to an emitter-follower circuit comprising transistor 750 and resistors 752-755. Capacitor 751 blocks DC voltage. The output of the emitter-follower circuit is applied through capacitor 757 and resistor 756 to a terminal of directional coupler 778. The VLF modulated signal is then applied from directional coupler 778 to the drop cable for transmission to the attached ECU on the SPU-to-ECU communication channel.

For enabling each of a plurality of SPUs (i.e., a master SPU and one or more slave SPUs) connected to a drop cable to selectively communicate with the ECU, each SPU is given a unique address at the time the SPU is installed in the subscriber's residence. This is accomplished by placing appropriate jumper wires in jumper block 782. Jumper block 782 has 2 jumper connections, each representing one bit of a 2-bit address. By selectively jumping the terminals in jumper block 782, each SPU attached to an ECU may be assigned any of 4 different addresses. In addition, switch 780 serves to identify the SPU depending on whether the switch is opened or closed as either a master SPU associated with a primary SU in the ECU, or a slave SPU associated with a secondary SU in the ECU. Typically, the master SPUs are assigned binary address 00 in jumper block 782, and slave SPUs are assigned any address 01, 10, or 11 in jumper block 782.

Communication between the ECU and its associated SPUs is via separate transmit and receive channels over the drop cable. As mentioned above, the first channel, the ECU-to-SPU channel, is a VLF channel having a carrier frequency of 430 KHz. The second channel, the SPU-to-ECU channel, is a VLF channel having a carrier frequency of 468 KHz. Both channels carry data at a rate of 1200 bps, although other convenient data rates may be used. Each SPU associated with an ECU transmits data to the ECU on the common SPU-to-ECU channel. Similarly, the ECU transmits data to each associated SPU on the common ECU-to-SPU channel.

#### VIII. Head End

Elements 34 and 36 of head end 12 are shown in greater detail in Figure 8. The forward and reverse data signals on cable network 14 are



coupled to combiner 800 by combiner 32. Combiner 800 applies the forward data signal from the modulator portion 810 of modem 34 to combiner 32, and applies the reverse data signal from combiner 32 to the demodulator portion 840 of the modem.

Central control computer 36, which may be any suitable computer such as a conventional Intel 330 computer, includes conventional main central processing unit ("CPU") 880, conventional main memory 882, conventional output buffer unit 884, and four conventional main input buffer units 886-889. All of elements 880, 882, 884, and 886-889 are conventionally interconnected via communications bus 890. Depending on the data rates and the speed of operation of buffer units 884 and 886-889, it may be possible to combine the functions of units 884 and 886-889 into a smaller number of buffer units. Main CPU 880 includes or is coupled to conventional input/output devices (not shown) for use by the operators of the system to control the system.

Each of buffer units 884 and 886-889 includes a conventional high level data link ("HDLC") controller portion, a conventional CPU portion, and a conventional memory portion. The HDLC controller portion of output buffer unit 884 converts parallel forward data originated by main CPU 880 to a serial NRZI forward data signal. This forward data signal is applied to conventional EIA RS 422 interface device 812 in the modulator portion 810 of modem 34. Interface device 812 applies the forward data signal to conventional TTL buffer 814. TTL buffer 814 applies the forward data to PIN diode switch 816 which frequency modulates the forward data signal by switching back and forth between 103.9 MHz and 104.1 MHz oscillators 818 and 820 in accordance with the applied data signal. The frequency modulated forward data signal is applied to surface acoustic wave bandpass

filter 822 and then to combiner 800 for application to cable network 14 via combiner 32.

Considering now the elements which receive, demodulate, and process the reverse data signals, it will be recalled that there are four reverse data channels having frequencies of 19.125 MHz, 19.375 MHz, 19.625 MHz, and 19.875 MHz, respectively, and that the reverse data is in NRZI protocol. All of these reverse data signals are passed through conventional bandpass filter 842 and conventional preamplifier 844. The output signal of preamplifier 844 is applied to four similar demodulator circuit paths, only one of which is shown in detail in Figure 8. Each of these circuit paths demodulates the reverse data signal in a respective one of the reverse data channels.

In each of the above-mentioned circuit paths, the reverse data signal is mixed by mixer 850 with the output signal of local oscillator 852 having a frequency selected such that the associated reverse data channel signal frequency minus the local oscillator frequency equals 10.7 MHz. Mixer 850 therefore shifts the associated reverse data channel signal to 10.7 MHz. The output signal of mixer 850 is applied to bandpass filter 854 which eliminates all signals other than the 10.7 MHz modulated signal. The output signal of bandpass filter 854 is applied to conventional intermediate frequency ("IF") amplifier 856. IF amplifier 856 is augmented by conventional carrier detector device 858 which applies a request to send ("RTS") output signal to conventional EIA RS 422 interface device 866 whenever a 10.7 MHz signal is detected. Conventional Costas loop device 860 converts the 10.7 MHz data signal to a baseband data signal which is applied to interface device 866. The baseband data signal is also applied to program logic array 862 which uses the data signal and the

higher frequency output signal of oscillator 864 to produce a clock signal pulse during each bit interval in the associated NRZI data signal. This clock signal is also applied to interface device 866.

Interface device 866 applies the carrier detect, clock, and NRZI data signals to the associated input buffer device 886-889. The HDLC controller portion of the buffer device converts the serial NRZI data to parallel data suitable for further processing by central control computer 36.

#### IX. ECU Operation

Microprocessor 420 (hereafter sometimes the "Data Processor") is responsible for controlling the overall operation of the ECU. This responsibility includes communicating with the CCC at head end 12, initiating, implementing and coordinating various operations within the ECU, and communicating with the SPUs. The Data Processor is aided in its functions by microcomputer 450 (hereafter sometimes the "Drop Processor"). The Drop Processor is responsible for transmitting to associated SPUs messages originated by the Data Processor, and for transmitting to the Data Processor messages originated by the SPUs. In addition, the Drop Processor on command from the Data Processor controls various functions associated with the SUs of the ECU. The operations of the Data Processor and Drop Processor in communicating with the CCC at head end 12 and with associated SPUs, and in implementing and controlling various ECU functions, will now be described.

##### A. ECU/SPU Communication Protocol

The communication protocol between an ECU and its associated SPUs must allow for the prompt detection and servicing of channel selection, pay-per-view requests and other subscriber-originated

requests from any of a plurality of SPUs (both master and slave) associated with any of up to six drop cables. Moreover, the communication protocol must be capable of detecting requests which are sporadic and infrequent.

#### 1. ECU/SPU Polling

To ensure the prompt servicing and processing of subscriber-entered SPU requests, communication access to the ECU is controlled by the ECU's digital unit 55 using a two-level polling scheme. The first level is called "drop polling", and permits a very rapid polling or sensing of each drop associated with the ECU to identify a drop which has an SPU in need of service (i.e., having information to transmit to the ECU). Drop polling is accomplished without transmitting or receiving any data over the relatively low-speed (in one embodiment, 1200 bps) ECU/SPU data link.

Once a particular drop has been identified by the ECU as requiring service, and if necessary because of the existence of more than one SPU attached to the drop, the ECU uses a second level of polling, called "device polling", to differentiate between SPUs. In this event, the communication link is used to specifically address each SPU attached to the drop to determine which SPUs require service. The ECU maintains maps in its memory of each drop, and of each device on each drop. The data of each map is in a predetermined order so as to optimize response times or to give priority to certain SPUs.

#### Drop Polling

Drop polling is controlled by microcomputer 450 in ECU digital unit 55 (Figure 5e) and multiplexer 350 in communication unit 56 (Figure 4). If an SPU requires service (e.g., a subscriber has

entered a channel request into the SPU's keyboard), SPU microcomputer 700 causes VLF modulator 740 to transmit a continuous 468 KHz carrier signal to the ECU. This continuous carrier signal is called a "cry" or "Service Request" signal. At the ECU, microcomputer 450 selects a drop by sending a drop address code to multiplexer 350 via the multiplexer's address lines A, B and C (Figure 4) to selectively connect the ECU's VLF modulator 320 and demodulator 340 to a particular one of the six drops. Once connected to a drop via multiplexer 350, ECU digital unit 55 listens for the presence of carrier signal (a Service Request) on the drop. If carrier signal is present on the drop and detected by the ECU, this is interpreted by the ECU to mean that an SPU on the drop requires service. If no carrier signal is detected on the drop, the ECU interprets this to mean that no SPUs on the drop require service. In this latter event, the ECU (via multiplexer 350) selects another drop in a predetermined sequence, and listens for the presence of carrier on that drop. If carrier is present, then an SPU attached to the drop requires service.

It should be noted that SPUs on the several drops request service simply by activating carrier on the SPU-to-ECU drop cable communication channel. It is not necessary for an SPU to transmit to the ECU any data or special commands to obtain service, thus allowing for very fast polling. To prevent any interference with communications already taking place on the drop, each SPU connected to the drop continuously monitors the ECU-to-SPU channel for the presence or absence of data. An SPU will activate carrier to transmit a Service Request only after the SPU has detected a predetermined number of (e.g., twelve) bit times of a continuous mark condition on the

ECU-to-SPU channel. This verifies to the SPU that there is no other communication on the drop cable.

#### Device Polling

Device polling is also controlled by microcomputer 450 in the ECU. As described above, if more than one SPU is attached to a drop on which a Service Request is detected, the ECU must individually poll the SPUs on the drop to determine which SPU has requested to communicate with the ECU. Irrespective of which SPU on the drop first requested service, device polling will occur in a predetermined order established by the ECU.

The ECU initiates device polling by transmitting conditional poll commands on the selected drop. All SPUs and other devices connected to the selected drop sense these commands and cease any activity (i.e., carrier transmissions) on the SPU-to-ECU link. The particular SPU being polled responds to the ECU with a single mark bit if the SPU does not require service. If the polled SPU requires service, the SPU responds by transmitting to the ECU an acknowledgement (a space bit) followed by data.

#### 2. ECU/SPU Message Formats

The communication of messages between an ECU and its associated SPUs is asynchronous with uniform bit timings and non-uniform, indeterminate character timings. The ECU-to-SPU link completely controls data transfers on the SPU-to-ECU link. Each character transmitted to the SPU by the ECU is acknowledged by the SPU with a one-bit acknowledged/not acknowledged ("ACK/NAK") handshake. This bit is also used for a poll response, as earlier described. Each character is preceded by at least one bit time of mark state. A mark-to-space transition resulting in a start bit in a space state initiates the character.

The next bit is a message framing bit, then eight data bits (transmitted low-order bit first), a parity bit, and at least one bit time of mark condition as an ending. The ending bit time of mark condition also serves as a lead-in to a possible subsequent character.

#### Character Framing

Character framing is established by the SPU sensing on the ECU-to-SPU link at least a predetermined number (e.g., twelve) bit times of a continuous mark condition followed by a mark-to-space transition resulting in a start bit. If an SPU loses character framing it will not recognize any commands until character framing is re-established by the ECU. The ECU periodically allows a given drop the opportunity to re-establish character framing by enforcing periods of continuous mark condition.

#### Message Framing

The manner in which a message character (data) is to be interpreted by an SPU is determined by the state (mark or space) of the message framing bit. The beginning of a message is indicated by a space condition (logical zero) in the message framing bit. A logical zero message framing bit means that the data field (8 bits) represents a command which all SPUs on the drop must interpret. On the other hand, if the message framing bit is in a mark condition (a logical one), then the data field is interpreted as containing subsequent information to a previous command. Any number of message characters can occur between command bytes. The incorporation of the message framing bit, although adding 1/11ths overhead to each message character, increases framing integrity and permits increased through-put when long data streams are encountered.

Without the message framing bit, the transmission of long data streams to or from an SPU would be curtailed or precluded in view of the need for the ECU to be able to rapidly poll and service up to 6 drops, each drop potentially having a plurality of SPUs. By utilizing the expedient of a message framing bit, the ECU may perform drop polling or even service other SPUs on other drops during the interstices between character transmissions to a specific SPU on a particular drop.

#### ACK/NAK and Poll Responses

The bit time immediately following the parity bit is used as an ACK/NAK window on the SPU-to-ECU link. Each character transmitted by the ECU is acknowledged by the SPU during the ACK/NAK window. This ACK/NAK window is also used in a special manner to respond to polls.

SPUs respond to the ECU during the ACK/NAK window as follows. Upon the receipt of an initial message start bit, all SPUs on the drop turn off carrier on the SPU-to-ECU link. Upon receipt of the message framing bit, if the bit is a space, all SPUs input the data bits (which represent a command) to check for the presence of their address. If the message framing bit was a mark, then only the previously addressed SPU on the drop inputs the data bits.

Upon receipt of the last data bit, the addressed SPU turns on its carrier on the SPU-to-ECU link. Upon receipt of the parity bit, if the parity bit indicates an error in transmission, then the SPU leaves its carrier on during the next bit time as a NAK signal to the ECU. If the parity bit indicates correct transmission, then the SPU turns its carrier off and maintains the carrier off during the next bit time as an ACK signal to the ECU.



If the data is a correctly transmitted poll, then the polled SPU after receipt of the parity bit turns its carrier off by transmitting the start bit of the information it has to transmit to the ECU. Otherwise, carrier is maintained on during the ACK/NAK window. One bit time after receipt of the parity bit (i.e., after the ACK/NAK window), all SPUs turn carrier off in preparation for another transmission to or from the ECU.

#### B. ECU/SPU Messages

Communications from the Data Processor to the Drop Processor are in the form of variable length messages representing commands which the Drop Processor executes. Execution by the Drop Processor of a Data Processor command normally follows a handshaking sequence requiring the Drop Processor to return a command response to the Data Processor. This command response may be a single byte acknowledgment, or a multiple byte response if the Data Processor command requires a return of data. However, if the Data Processor command requires the Drop Processor to send a message to a device attached to a drop cable, as described below, a command response may not be required.

In addition to command responses, information may be passed to the Data Processor from the Drop Processor without any commands having been issued by the Data Processor. Such a transfer would occur, as further described below, in the event that a device attached to a drop cable transmits a Service Request to the ECU. In such an event, the Drop Processor will read data from the device requesting service and pass the information to the Data Processor as an Unsolicited Data Response.

The following table sets forth the Data Processor/Drop Processor communication commands uti-

lized in one embodiment of the invention. Commands having an asterisk are sent from the Drop Processor. The other commands are sent from the Data Processor.

TABLE C

<u>COMMAND (HEX)</u>	<u>FUNCTION</u>
00	Reset drop processor.
01	Read power detect and bank address.
03	Change tuner frequency (channel select).
04	Send message to attached device.
05	Turn converter on/off and select cable A or cable B.
07	Define drop poll sequence.
08	Define device poll sequence.
84*	Unsolicited Data Response from attached device.

Briefly, the commands set forth in Table C operate as follows:

Command 00. This is a one-byte command message used by the Data Processor to reset the Drop Processor and to initialize its registers and pointers. All polling activities are discontinued. The Drop Processor acknowledges receipt of this command by returning to the Data Processor a single command response byte equal to 00.

Command 01. This is a one-byte command message used by the Data Processor to cause the Drop Processor to read the state of the six power detect lines (POWER DET, Figure 2) from the subscriber units SU1, SU2, etc., and to read the bank to which the

ECU's address is assigned. The response sent by the Drop Processor to this command comprises two bytes. The first byte echoes the command byte (01). The second byte is a data byte which specifies the state of each of the POWER DET lines and the ECU's bank address. For each of the POWER DET lines of the six subscriber units, corresponding bits 0-5 of the response byte are set to 1 or 0 depending respectively on whether or not power is being supplied to the drop cable by the subscriber connected to that subscriber unit. Bits 6 and 7 of the response data byte specify to which one of four banks the ECU's address is assigned.

Command 03. This is a four-byte command message used by the Data Processor to cause the Drop Processor to tune any of the ECU's six associated SUs to a specified physical channel. The first byte is the command byte (03). Next are three bytes of data. The first byte specifies in bits 0-2 which one of the six SUs is to be tuned. The next two bytes specify the two MS numbers, earlier described, which are required by the circuitry of the SU's tuner/converter to tune to a particular physical television channel. The Drop Processor sends a two-byte command response to the Data Processor upon receipt of the command echoing the first two bytes of the command message.

Command 04. This command message (hereafter the "04 Command") is used by the Data Processor to cause the Drop Processor to send an addressed message to a device attached to a drop cable. In one embodiment, the device may be an SPU having an address equal to 2, 3, 4 or 5, or the device may be some other type of apparatus attached to the drop cable and capable of communicating with the ECU. Examples of such other devices are medical monitoring equipment, fire alarms, smoke alarms, burglary

alarms, and so forth. Such other devices may have addresses equal to 0, 1, 6 or 7.

The 04 Command message to the Drop Processor includes at least four bytes, as follows: (1) in the first byte, the command code (04), (2) in the second byte, the drop number (bits 0-2) and the device address from 0-7 (bits 3-7), (3) in the third byte, the number of bytes contained in the message, and (4) in the fourth byte, a device command. Following the device command byte are one or more data bytes. The device command and data bytes together comprise the message. The device command byte includes a 3-bit device address (bits 0-2) and a 5-bit function code (bits 3-7). The function code is used to command a particular operation in the addressed device. The following table sets forth the function codes used to control SPU or device operation in one embodiment of the invention:

TABLE D

<u>FUNCTION CODE (HEX)</u>	<u>DEVICE OPERATION</u>
00	Read internal status, and return a response message to the ECU.
01	Turn on or off the order event lamp.
02	Set the order-event lamp to flashing or non-flashing mode.
03	Enable or disable data input to the device.
04	Enable or disable data output from a device.
05	Turn the television power relay on or off.
06	Blank the display.
07	Set the display to flashing or non-flashing mode.
08	Display a character in the right-most position of the display.
09	Transmit a number of characters to the ECU as specified by the byte count of the 04 Command message.
0A	Display a character at a specified position of the display.
0B	Conditional poll to determine the identity of the device sending a Service Request. The device returns its data.

If the device message requires the device to return a response to the ECU (e.g., in response to function codes 00, 09, or 0B), a command response (hereafter the "04 Response") is returned from the Drop Processor to the Data Processor. This response includes a three-byte response header followed by one or more data bytes. The response header includes: (1) in the first byte, a command response code (hex 04), (2) in the second byte, an echo of the drop and device address byte originally sent by the Data Processor, and (3) in the third byte, the number of bytes of data in the response message. Assuming no transmission errors occurred, following the response header are one or more response data bytes. The data byte of an error-free 04 Response to a conditional poll, for example, may identify the key which the subscriber has depressed. Or, in the case of an error-free 04 Response to a status request message, the data byte may specify by its bit settings the device status as follows: the device is a master or slave SPU (bit 7), the order event lamp is flashing (bit 5), the order event lamp is on (bit 4), the television power relay is on (bit 3), there has been recent power on (bit 2), a key has been recently depressed (bit 1), and a new character is available (bit 0). If a transmission error occurred, the byte count is 00. In this event, a single data byte follows the byte count to specify an error code. The error code may be 01 (indicating an ECU-to-device transmission (parity) error), 02 (indicating a device-to-ECU transmission (parity) error), or 03 (indicating an invalid device response). Error codes are sent to the Data Processor only after the occurrence of five consecutive link transmission errors.

Command 05. This command is used by the Data Processor to cause the Drop Processor to turn on or off a particular SU and, in a two-cable system,

to cause the SU to select either cable A or cable B. The command message includes two bytes. The first byte is the command code byte (hex 05). The second byte specifies (1) the SU (bits 0-2), (2) the selected cable (bit 6 is set to 0 or 1 to select cable A or B, respectively), and (3) whether to turn the SU unit on or off (bit 7 is set to "0" or "1", respectively). A two-byte command response is returned to the Data Processor by the Drop Processor. The first byte echoes the command byte (05). The second byte includes in bits 0-2 the SU address contained in the command message.

Command 07. This command is used by the Data Processor to load a drop polling map into the Drop Processor to define the drop polling sequence. The command message includes five bytes. The first byte is a command code byte (hex 07). Bytes two through four specify the drop polling sequence. Each of these bytes is divided into two nibbles of four-bits per nibble. The value of each nibble is set from 0-5 to specify in each nibble a particular drop. Drops are sequentially polled in the order specified by the nibbles as received by the Drop Processor from the Data Processor. A value of hex F in a nibble indicates the end of the polling map. If all nibbles contain hex F, drop polling is disabled. The fifth byte would include an F in its high order nibble to indicate the end of a polling map for six drops. A one-byte command response (07) is sent by the Drop Processor to the Data Processor echoing the command code byte.

Command 08. This command is used by the Data Processor to load a device polling map into the Drop Processor to define the device polling sequence. This command message includes seven bytes. The first byte is the command byte (hex 08). The second byte specifies the drop in bits 0-2. Bytes three through

six specify in each of eight nibbles a device address. Devices on the specified drop are sequentially polled in the order specified by the device address nibbles as received by the Drop Processor from the Data Processor. A value of hex F in a nibble indicates the end of the device polling map. If all entries in the device polling map are set to hex F, device polling is disabled. The seventh byte would include an F in its high order nibble indicating the end of a device polling map for eight devices. A two-byte command response is sent by the Drop Processor to the Data Processor echoing the first two bytes of the Data Processor's command message.

Command 84. This command (hereafter the "84 Command") is sent from the Drop Processor to the Data Processor indicating the receipt by the Drop Processor of unsolicited data from a device attached to a drop cable. The 84 Command is used by the Drop Processor to transmit to the Data Processor data received from a device which has transmitted a Service Request to the ECU (e.g., a subscriber has entered a channel selection request via SPU keyboard). This command message includes at least four bytes. The first byte contains the command code (hex 84). The second byte specifies the drop address (bits 0-2) and the device address (bits 3-7) to identify the particular drop and device sending the Unsolicited Data Response. The third byte specifies the number of data bytes being sent by the device. Finally, the fourth byte is a data byte. If the byte count is 00, an error has occurred. In such a case, an additional byte follows the data count byte specifying an error code. An error code of 01 indicates an ECU-to-SPU transmission (parity) error. An error code of 02 indicates an SPU-to-ECU transmission (parity) error.



C. Drop Processor Operation

Figures 9a-9b illustrate flow charts of a computer program utilized in one embodiment of the invention for controlling the operations of the Drop Processor. An object and source code computer program listing which will be readily understood by those skilled in the art for controlling the operations of the Drop Processor in accordance with the flow charts of Figures 9a-9b is annexed as Appendix B.

The program controlling the Drop Processor includes a Main Routine (Figure 9a) and a Timer Interrupt Routine (Figure 9b). Each of the two routines runs independently of the other. The Main Routine is periodically interrupted by the Timer Interrupt Routine, in a conventional manner, after a predetermined time period has elapsed as determined by the timing out of an interrupt timer. The function of the Drop Processor Main Routine is to (1) receive data from the Timer Interrupt Routine (e.g., a message from an SPU to the ECU) and send it to the Data Processor, and (2) to send data from the Data Processor to the Timer Interrupt Routine for, ultimately, transmission to SPUs. The function of the Timer Interrupt Routine is to (1) implement drop and device polling, (2) transmit messages to and receive messages from SPUs attached to the drops, and (3) send signals to and receive signals from the SUs.

1. Main Routine

As shown in Figure 9a, the program flow of the Main Routine begins at step 901 where various buffers, counters, flags and ports are initialized. Also at step 901, drop polling and device polling are initialized, and register R5 (described in more detail below) is set to three. At steps 902 and

903, the address for jumping to the Timer Interrupt Routine is set and the interrupt timer is activated.

Initialization is complete when the program flow advances to step 904. At step 904, the Main Routine interrogates the state of an Input Buffer Full ("IBF") flag. This flag is associated with a Drop Processor buffer which receives data passed to the Drop Processor from the Data Processor. If the IBF flag indicates that the input buffer is full, the program flow advances to step 905. Otherwise, the program flow branches to step 906.

Assuming first that the IBF buffer is not full the program advances to step 906, where the Drop Processor checks a buffer (the 84 Buffer) to determine whether or not a device attached to a drop has sent an Unsolicited Data Response (i.e., an 84 Command). If so, the program advances to step 907 to pass the 84 Command to the Data Processor. Otherwise, the program advances to step 908 where the Drop Processor determines if a device has sent an 04 Response. If "no", the program loops to step 904 to again check the IBF flag as earlier described. If "yes", the program advances to step 909 to pass the 04 Response to the Data Processor. From step 909 (or step 907 if the program advanced to that step), the program loops to step 904.

If at step 904 the IBF flag indicates that the input buffer is now full, the program advances to step 905 where the contents of the buffer are input and the IBF flag is cleared. The program flow then advances to step 910 where the Drop Processor determines what type of command (earlier described) was included in the message sent by the Data Processor. Depending upon the command, the program at step 910 may branch in any of three directions.

If command 00 (reset) was sent, the program flow advances to step 920, where the Drop Processor

sends a 00 command response message to the Data Processor via an output buffer associated with the Drop Processor. The program flow then loops to step 901 to re-initialize the Drop Processor as previously described.

If at step 910 any of commands 00, 03, 05, 07 or 08 was sent by the Data Processor, the program flow advances to step 911. At step 911, the Drop Processor processes the particular command as earlier described. The program flow then advances to step 912, where the Drop Processor sends to the Data Processor an appropriate command response. From step 912, the program flow loops to step 904.

Finally, if step 910 determines that an 04 Command message was sent by the Data Processor, the program flow branches to step 913. At step 913, the Main Routine interrogates a flag indicating the state (empty or full) of an "04 Buffer" associated with the Drop Processor. The 04 Buffer contains data to be sent by the Drop Processor to a device attached to a drop. If the 04 Buffer is empty, the program branches to step 914. Otherwise, the program branches to step 915.

If the program at step 913 advances to step 914 (i.e., the 04 Buffer is empty), step 914 places data received from the Data Processor into the 04 Buffer. The program flow then advances to step 917, where register R5 is checked. If the contents of register R5 are not equal to 0, the program branches to step 919 to decrement the contents of register R5 by one. Otherwise, the program advances to (1) step 918, where the contents of register R5 are initialized to a value of three and incremented by one, and (2) step 919 where the contents of register R5 are decremented by one. From step 919, the program flow loops to step 904 to again check the input buffer.

Returning now to step 913, if the 04 Buffer is not empty the program branches to step 915. At step 915, the Main Routine determines whether or not the 04 Buffer contains an 04 Response from an attached device. If "yes", the program advances to step 916 to pass that 04 Response data to the Data Processor. From step 916, the flow advances to step 914 to input the data received from the Data Processor. On the other hand, if "no" at step 915, the program advances to step 921 where the contents of register R5 are checked. If the contents of register R5 are not equal to 0, the program loops to step 913 to again interrogate the state (empty or full) of the 04 Buffer. Otherwise, the program from step 921 advances to step 922 to check the state of the 84 Buffer. If the 84 Buffer is empty, the program immediately loops to step 913. However, if the 84 Buffer contains data at step 922, the program advances to (1) step 923 to pass the data to the Data Processor as an 84 Command, (2) step 924 to reset the R5 register to a count of three. The program then loops to step 913.

## 2. Timer Interrupt Routine

A flow chart of the Timer Interrupt Routine is illustrated in Figure 9b. As shown in Figure 9b, the Timer Interrupt Routine starts at step 950 to initialize the drop and device maps and clear various flags and buffers. The program then advances to step 951, where a determination is made as to whether ("yes") or not ("no") a Service Request exists on the drop to which the Drop Processor is connected via multiplexer 350 (Figure 4).

Assuming first that no Service Request is detected at step 951, the program branches to step 966 where the 04 Buffer is checked to determine whether or not the Drop Processor has received an 04

Command from the Data Processor for transmission to a device attached to a drop cable. If not, the program advances to step 960 to update the drop polling map pointer. If the pointer is not pointing to the end of the drop map, the program increments the drop map pointer in step 965, initializes the device map pointer to the beginning of the device map, and loops to step 951 to listen for the presence of a Service Request on another drop. On the other hand, if at step 960 the program determines that the drop pointer is at the end of the drop map, the program advances to step 961 to reset the drop map pointer to the beginning of the drop map prior to advancing to step 962 and then to step 951 as described above.

Returning to step 966, if the 04 Buffer contains an 04 Command to send to a device, the program flow advances to step 973 after setting a flag ("1") in step 967. At step 973, the Drop Processor transmits the 04 Command message to the appropriate device. The program then advances to step 974 to determine whether or not a transmission error occurred. If an error occurred, the program branches to step 972. If less than five errors have occurred, the program advances from step 972 to step 973 to re-transmit the 04 Command. On the fifth error, however, the program branches from step 972 to step 975 where an 04 Response containing an appropriate error code is transmitted from the Drop Processor to the Data Processor as earlier described. From step 975 in the event of an error, or step 974 in the event of no error, the program advances to step 976 to check the state of the "1" flag. Because the program advanced from step 967, the "1" flag will earlier have been set. Accordingly, the program from step 976 advances to step 960 to increment or initialize the drop map pointer as previously described.

Assuming now that a Service Request is detected at step 951, the program advances to step 952 where a conditional poll command (earlier described) is transmitted on the drop on which the Service Request was detected. At step 953, the Drop Processor determines whether an ACK or a NACK (earlier described) is returned in response to the poll. Assuming first that a NACK is returned, the program branches to step 968 to determine whether or not a transmission error occurred. If "yes", the program advances to step 969 to return an appropriate error code to the Data Processor. Otherwise, the program advances to step 970 to determine whether or not an 04 Command has been received from the Data Processor for transmission to a device. If "yes", the program advances to step 973 to transmit the 04 Command as previously described. Otherwise, the program advances to step 959 to determine whether or not the device map pointer is at the end of the device poll map. If the program is not at the end of the device map, the device map pointer is incremented at step 963 and a conditional poll command to the next device is sent at step 952. If the program is at the end of the device map, the program advances from step 959 to step 960 to update the drop map pointer and loop as previously described.

Assuming now that an ACK is detected at step 953 (signifying that the polled device has an Unsolicited Data Response to transmit to the ECU), the program advances to step 954 to input the unsolicited data. Steps 955, 956 and 964 determine as previously described with respect to steps 972, 974 and 975 whether or not five transmission errors occurred. In the event of five errors, an appropriate error code is sent to the Data Processor at step 964. From step 964 or step 955, the program advances to step 957 to check an output buffer full ("OBF")

flag indicating whether the Drop Processor's output buffer to the Data Processor is full or empty. If the buffer is empty, the program advances to step 958 where the unsolicited data is sent to the Data Processor as an 84 Command via the Drop Processor's output buffer. The program then advances to step 959 to update the drop and device map pointers as previously described. Alternatively, if the output buffer is full at step 957, the program advances to step 971 to determine whether or not the Data Processor has sent an 04 Command to the Drop Processor for a device attached to a drop cable. If there is no 04 Command to send at step 971, the program loops to step 957. On the other hand, if there is an 04 Command to transmit, the program advances to step 973 to transmit the 04 Command as previously described. At step 976, because the "1" flag this time is not set, the program loops back to step 957.

D. CCC/ECU Communication Protocol

1. Message Format

A typical data message format used in one embodiment of the invention for communicating information between the central control computer (CCC) at head end 12 and the plurality of ECUs connected to cable network 14 will now be described with reference to Figures 10 and 11.

A basic message format for data communication in the forward direction (i.e., from the CCC to an ECU) is illustrated in Figure 10a. As shown in Figure 10a, each message is of a predetermined format, comprising: a FLAG byte, two ADDRESS bytes specifying an ECU address, a BYTE COUNT byte ("N"), a COMMAND byte ("CMD"), a plurality of DATA bytes, two CYCLIC REDUNDANCY CHECK ("CRC") bytes, and another FLAG byte. Each byte is comprised of 8 bits.

The FLAG bytes identify the beginning and end of a message. Each FLAG byte has a unique bit pattern ("01111110"). At the end of a message, if there are no more messages available for transmission by the CCC, the CCC transmits repetitive FLAG bytes to maintain synchronization on the communications link. Otherwise, the end FLAG byte serves as the start FLAG byte of the next message.

The two ADDRESS bytes typically specify the address of a particular ECU from 0001 (hex) through FFFE (hex). The use of two ADDRESS bytes in this matter to specify an ECU address allows the CCC to uniquely address a message to any particular one of 65,534 ECUs. The first address byte (ADH) specifies the high-order part of the address, and the second byte (ADL) specifies the low-order part. Two addresses have special meanings. Address FFFF (hex) is a global or broadcast address. All ECUs respond to a message containing the broadcast address. Address 0000 is a "mask" address, described in detail below.

The BYTE COUNT byte (N) specifies the number of bytes following in the message, exclusive of CRC and FLAG bytes. Following the BYTE COUNT byte is a COMMAND byte (CMD). As discussed in detail below, the COMMAND byte specifies the type of message being transmitted and the manner in which subsequent DATA bytes should be interpreted.

The CRC bytes (CRH and CRL) are two bytes which together form a conventional 16-bit CRC number. These two bytes are derived from a mathematical manipulation of all bits (exclusive of the FLAG bits) preceding the CRC bytes, and serve as a check that the message was accurately transmitted to and received by the ECU. The derivation of the CRC bytes is accomplished in a conventional manner in



accordance with standards promulgated by international standards organizations, such as the CCITT.

The use of ADDRESS 0000 (the mask address) enables a message to be directed to any particular ECU or group of ECUs. The basic format of a message having an address of 0000 is illustrated in Figure 10b. As shown in Figure 10b, a message having a mask address equal to 0000 differs from a basic message (Figure 10a) by the inclusion of four additional bytes following the ADDRESS bytes. These four bytes are two MASK bytes ("MH" and "ML") followed by two REFERENCE bytes ("RH" and "RL"). Any ECU receiving a message having a 0000 mask address will logically AND the ECU's unique address with the values of the MASK bytes. If the result of this logical operation equals the values set forth in the REFERENCE bytes, the ECU will recognize the message as addressed to it and respond accordingly. Otherwise, the ECU will ignore the message. As will be readily apparent to those skilled in the art, the use of the mask address in this manner allows a single message to be transmitted to any one or a selected group of ECUs. For example, if the MASK bytes are 0001, and if the REFERENCE bytes also are 0001, then all ECUs having odd addresses will respond to the message. On the other hand, if the REFERENCE bytes are changed to 0000, then all ECUs having even addresses will respond to the message.

A basic message format in the reverse direction (i.e., from the ECUs to the CCC) is shown in Figure 11, and is similar to the format for forward communication shown in Figure 10a. Thus, unique FLAG ("01111110") bytes are used to identify the beginning and end of a message. Following the beginning FLAG byte are two ADDRESS bytes which specify the address of the particular ECU sending the message. Next follow a BYTE COUNT byte (N), a

COMMAND byte (CMD), and DATA bytes. Two conventionally derived CRC bytes follow the last DATA byte as earlier described.

Referring now to Figures 12 through 17, there are shown illustrative examples of several typical messages sent between the CCC and an ECU in one embodiment of the invention. The messages of Figures 12 through 17 are formatted in accordance with the basic message formats of Figures 10-11.

Figure 12 illustrates a WRITE message sent from the CCC to an ECU. The WRITE message may be used to write a program or data to any one or a plurality of ECUs commencing at a specified address in the ECU's memory. The use of the WRITE message in this way enables the cable system operator to add new functions and services to the ECU, or to modify existing ones. Thus, the operation of the cable system may be readily enhanced or modified without having to replace or modify the ECU or SPU hardware.

The WRITE message may be used to implement a variety of functions in an ECU. For example, the WRITE message may be used to download a Channel Authorization Map in an ECU specifying which television channels each associated subscriber is authorized to view. In one embodiment, the Channel Authorization Map comprises a string of 128 bytes of data stored in the ECU's memory, each byte associated with a different one of 128 so-called logical channels. A logical channel is that channel which a subscriber requests by entering a channel number into the SPU. Each of the first six bits of each byte in the Channel Authorization Map is associated with a different one of six SUs. A bit is set to "1" or to "0" depending respectively on whether or not the subscriber associated with that bit and SU is authorized to view the television channel associated with that byte. To transmit a Channel Authorization Map to an ECU, a

WRITE command may be used specifying the start address of the map in the ECU's memory and the 128 bytes of logical channel data. The use of the WRITE command to transmit a new or replacement Channel Authorization Map enables the cable operator to add or delete authorized channels for particular subscribers as a function, e.g., of whether or not the subscriber has paid his or her bill, whether the subscriber has requested to subscribe to view additional or fewer channels, and so forth.

As another example, the WRITE command may be used to transmit to an ECU a so-called Channelization Map specifying a correlation between logical channels and physical channels. As earlier described, physical channels are the channels carried on the CATV feeder cable to which the converter/tuner in the SU tunes in response to subscriber requests to view a particular logical channel. For example, the Channelization Map might correlate logical channel 7 with physical channel 52, logical channel 9 with physical channel 15, and so on. In one embodiment having a single feeder cable, the Channelization Map in each ECU includes 128 bytes of data (in a two cable system, the Channelization Map would include 256 bytes of data). The data are grouped in pairs such that each pair of bytes is associated with a different one of 64 (or 128 in a two cable system) logical channels. Thus, the first byte pair is associated with logical channel 0, the second byte pair with logical channel 1, and so on. Each pair of bytes specifies the two MS numbers, earlier described, which are the tuning information required by the converter/tuner of each SU to tune to a particular physical channel. By changing the values of the MS numbers in the Channelization Map using the WRITE message, the CCC can dynamically (i.e., on any given day and at any given time) re-define the logical

channel/physical channel correlation. This allows the cable system operator to transmit a television program on any available physical cable channel while allowing the subscriber to always view that program by selecting the same logical channel. This is important in situations of large amounts of noise on a particular physical channel which degrades the television signal. In such an event, the system operator can transmit a new Channelization Map to re-define the physical channel/logical channel correlation to associate a less noisy physical channel with the logical channel, and transmit the program on the less noisy channel. The subscriber, however, will still access the channel carrying the program the subscriber desires to view by keying into the SPU the same logical channel number.

As shown in Figure 12, a WRITE message includes the usual two ADDRESS bytes (ADH and ADL) specifying the particular ECU to which the message is directed, and a BYTE COUNT byte (N) specifying the number of bytes following in the message. Next appears a COMMAND byte equal to hex FC ("11111100"). This COMMAND byte identifies the message as a WRITE message. After the COMMAND byte is a DATA COUNT byte (NN) specifying the number of bytes of data contained in the WRITE message to be written to the ECU's memory. Next, two bytes ("MDL" and "MDH") specify in low and high order parts, respectively, the specific ECU memory address at which the write operation should commence. Finally, there follow NN bytes of data to be written to the ECU's memory.

Another message sent from the CCC to an ECU is a READ message, illustrated in Figure 13a. A READ message enables the CCC to obtain one or more bytes of data from an ECU commencing at a specified address of the ECU's memory. The READ message may be used for a variety of purposes. For example, the

READ message may be used to determine which subscribers are authorized to view which channels, which subscribers should be charged a fee for viewing pay-per-view programs, and so forth. Also, the READ message may be used to examine various portions of an ECU's data or program memory to diagnose faulty or failing ECUs.

As shown in Figure 13a, a READ message includes the usual ADDRESS (ADL and ADH) and BYTE COUNT (N) bytes. After these bytes is a COMMAND byte which may be any value equal to hex F8, F9, FA or FB (11111000, 11111001, 11111010 or 11111011). Each COMMAND byte F8 through FB specifies that the message is a READ message. However, each COMMAND byte also specifies by the values of the two least significant bits on which one of the four available reverse channels the ECU should return data to the CCC. Thus, COMMAND bytes F8, F9, FA and FB specify that the ECU should return data to the CCC on reverse channel 00, 01, 02 and 03, respectively. Following the COMMAND byte is (1) a DATA COUNT byte (NN) specifying how many data bytes to return to the CCC, and (2) two memory address bytes (MADL and MADH) specifying in low and high order parts the ECU memory address at which the data READ operation should commence.

In response to a READ message, the ECU returns to the CCC on the specified reverse channel a message as shown in Figure 13b which includes the data requested by the READ message. The returned message includes the usual ADDRESS and BYTE COUNT bytes, followed by a COMMAND byte set to the value of the read command to which the return message is responsive. Next follow a DATA COUNT byte (NN) specifying the number of bytes of returned data, and the NN bytes of data requested by the READ message.

Still another message sent from the CCC to an ECU is an ECHO BACK message, illustrated in Figure 14. An ECHO BACK message causes an addressed ECU to return to the CCC on a specified reverse channel a message which is identical to that received by the ECU. The ECHO BACK message may be used to test the cable network for signal degradation and transmission errors, and may also be used to locate non-operating ECUs.

As shown in Figure 14, an ECHO BACK message includes the usual ADDRESS (ADL and ADH) and BYTE COUNT (N) bytes. Next is a COMMAND byte which may be any value equal to hex F0, F1, F2 or F3 (11110000, 11110001, 111100010 or 11110011). As previously described with respect to the READ message, the last two bits of the COMMAND byte specify on which one of the four reverse channels the ECU should echo back the CCC's message. After the COMMAND byte is a DATA COUNT byte (NN) followed by NN bytes of data.

In response to the receipt of an ECHO BACK message, the addressed ECU returns a message to the CCC as shown in Figure 14b on the specified reverse channel. Irrespective of the manner in which the message was addressed to the ECU (i.e., using a global, mask or specific address), the ECU's message includes the responding ECU's unique address in the ADH and ADL bytes, followed by a BYTE COUNT byte (N). Thereafter, the returned message is (assuming no transmission errors) identical to that originally sent from the CCC.

Yet another message sent from the CCC to an ECU is a FORCE TUNE message, illustrated in Figure 15. This message is used to cause an addressed ECU to force tune any drop associated with that ECU to any channel. Force tuning may be used, for example, to cause all subscriber television sets connected to

the CATV system to tune to a channel on which instructions and news may be communicated to subscribers in the event of a civil emergency. Also, this message may be used to automatically tune a subscriber's television set at the appropriate date and time to a channel carrying a pay-per-view program (such as a boxing match) which the subscriber requested to view.

As shown in Figure 15, a typical FORCE TUNE message includes the usual ADDRESS (ADL and ADH) and BYTE COUNT (N) bytes. Next follow a COMMAND (CMD) byte equal to hex F4 (11110100) to identify the message as a FORCE TUNE message, and a DATA COUNT byte (NN) equal to 2. Thereafter, a SUBSCRIBER UNIT (SU) byte specifies the particular subscriber unit to be force tuned. In one embodiment, the SU byte specifies any one converter using the byte's three least significant bits. This requires a FORCE TUNE message to be transmitted for each converter to be force tuned. Alternatively, each bit of the SU byte may be associated with a different one of six converters such that a single message to an ECU can force tune more than one converter associated with the ECU. Finally, a logical channel (LC) byte specifies the logical channel number to which the specified converter should be force tuned. If the SU byte is associated with more than one converter, there would be a plurality of LC bytes, one for each converter being force tuned.

Another series of messages sent from the CCC to an ECU are SEND FUNCTION messages. These messages are used to cause an ECU to return to the CCC so-called send function data accumulated by the ECU from the ECU's associated subscribers. Send function data is data keyed into SPUs by subscribers in response to requests for such data from the CCC at head end 12. For example, send function data may represent voting or shop-at-home data keyed in by

subscribers in connection with interactive viewer preference or shop-at-home services offered by the cable operator. In one embodiment, each ECU maintains in its memory a plurality of so-called send function bytes arranged in pairs. Each pair of send function bytes is associated with a different one of up to six subscribers. The first byte specifies the subscriber with which the byte pair is associated. The second byte contains the send function data. In addition to the byte pairs, the ECU maintains in its memory a send function count byte specifying the number of send function bytes in the ECU's memory. If the ECU's memory contains no send function data (e.g., no associated subscriber has entered send function data), the value of the send function count byte is zero.

In one embodiment of the invention there are six SEND FUNCTION messages. These messages are illustrated in Figures 16a through 16c. The first message is the SEND FUNCTION ENABLE message, shown in Figure 16a. In addition to the usual ADDRESS and BYTE COUNT bytes, this message has a command byte equal to hex 80, a DATA COUNT byte (NN), and a single DATA byte (SU). Each bit 0-5 of the (SU) byte is associated with a different one of six SUs. The SEND FUNCTION ENABLE message is used by the CCC to enable or disable the send function in an ECU with respect to particular SUs associated with that ECU. The send function with respect to a particular SU is enabled or disabled depending respectively on whether the setting of the bit of the SU byte associated with that SU is set to "1" or to "0".

The second message is the SEND FUNCTION CLEAR message, shown in Figure 16b. This message includes a COMMAND byte equal to hex 81, and a DATA



COUNT byte (NN) equal to 0. In response to the receipt of this message, the addressed ECU clears the send function data in its memory.

The third message is the SEND FUNCTION DATA message, shown in Figure 16c. This message includes a COMMAND byte which may have any value equal to hex 84, 85, 86 or 87 (10000100, 10000101, 10000110 or 10000111). Upon receipt of this message, an addressed ECU will return to the CCC the send function data in its memory only if the ECU has any send function data to send to the CCC (as determined by the value of the ECU's send function count byte). As previously described with respect to the READ message, the data will be returned by the ECU on the reverse channel (00, 01, 02 or 03) specified by the values of the two least significant bits of the SEND FUNCTION DATA message's COMMAND byte. In response to a SEND FUNCTION DATA message, the ECU sends a message to the CCC which includes one or more pairs of data bytes, each pair associated with a different SU. The first byte of the pair specifies an SU (from 0-5), and the second byte is the send data for that SU.

Yet another message available to be sent from the CCC to an ECU is a PAY-PER-VIEW message. This message is used to (a) force tune an SU to a pay-per-view event requested by the subscriber, and (b) turn on the subscriber's television apparatus via the subscriber's SPU power relay.

The PAY-PER-VIEW message used in one embodiment of the invention is shown in Figure 17 as including a COMMAND byte equal to hex 88. Next follows a DATA COUNT byte (NN). A PROGRAM NUMBER (PN) byte specifies the so-called program number, described in more detail below, to which the message relates. Finally, two MS bytes specify the MS numbers, earlier described, required to tune the con-

verter/tuner circuitry contained in the SUs to the particular physical channel carrying the pay-per-view event specified by the PROGRAM NUMBER byte.

The PAY-PER-VIEW message in one embodiment of the invention operates as follows. Each ECU includes an Event View byte in its memory. Each of bits 0-5 of this byte is associated with a different one of up to six SUs. When a subscriber tunes to a pay-per-view event, a bit of the Event View byte associated with the SU tuned to the pay-per-view event is set to "1". That bit is reset to "0" when the SU is tuned to a channel not associated with a pay-per-view event, or when the subscriber via the SPU turns off his or her television receiver. The Event View byte is used, as later described, to control the incrementing of a timer.

In addition to the foregoing, each ECU has a Program Event Map in its memory comprised of 128 pairs of bytes. Each byte pair of this map is associated with a different one of 128 program numbers. Each program number is associated with a different pay-per-view program event. Thus, the first byte pair of the Program Event Map is associated with program number or event 0, the second pair with program number or event 1, and so on. The byte pairs contain the MS numbers conveyed by the PAY-PER-VIEW message.

In addition to the Program Event Map, each ECU includes in its memory a Program Authorization Map. This map includes 768 bytes arranged in six groups of 128 bytes per group. Each group of 128 bytes is associated with a different SU, and each byte of each group is associated with a different one of 128 pay-per-view events. If a subscriber associated with a particular SU is authorized to view pay-per-view programs, and requests via

the subscriber's SPU to view a particular pay-per-view program, the three least significant bits of the byte associated with that program and SU are set to the address of the SPU from which the pay-per-view request was received. The five most significant bits of the byte, each initially zero, are used as a preview timer as later described.

To order a desired pay-per-view event, a subscriber enters the program number associated with the pay-per-view event into the keyboard of the subscriber's SPU. If the subscriber is authorized to view pay-per-view events, the address of the SPU from which the request was received is placed in the appropriate byte of the Program Authorization Map as described above. When the event begins, the CCC transmits a PAY-PER-VIEW message specifying the program number and the MS tuning data required by the converter/tuners of the SUs to tune to the program. If a subscriber has requested to view the pay-per-view program specified in the PAY-PER-VIEW message, the ECU force tunes the SU associated with that subscriber to the channel carrying the pay-per-view event. In addition, the ECU sends a command to the SPU to cause the SPU to (1) flash the SPU's event-order LED to signify that the subscriber is viewing a pay-per-view event during the preview period, and (2) turn on the SPU's television relay to supply power to the subscriber's television set. Thus, at the appropriate date and time, the ECU will turn on and force tune the subscriber's television set to the requested pay-per-view event. Also, the ECU will initiate operation of a preview period timer. During the preview period, a subscriber may view the pay-per-view event free of charge. If the subscriber views more than a predetermined number of minutes of the pay-per-view program, the preview timer will time out and the ECU will send a command to the SPU

to cause the event-order LED to glow continuously to signify that the subscriber will be charged a fee for viewing the event.

The preview timer operates as follows. Upon the timing out of a pay-per-view event timer, the ECU checks the state of the bit flags in the Event View byte. If the bit associated with an SU is set to "1", then a bit of the preview timer associated with the SU and program to which the SU is tuned (described above) is set to "1". Each of the five bits of the preview timers in the Program Authorization Map represents a fraction (i.e., one-fifth) of the preview period. Each time that the pay-per-view event timer times out, and if the associated bit of the Event View byte is set to "1", another one of the five bits of the appropriate preview timer is set by the ECU. When all five bits of the preview timer have been set, the preview period is over and the subscriber will be charged for the pay-per-view event. The CCC periodically collects the preview timer information contained in the Program Authorization Map using READ messages to determine which subscribers should be charged for viewing which pay-per-view events.

Although several messages have been described in detail with respect to an embodiment of the invention, it will be apparent to those skilled in the art that the message format utilized in the present invention can accommodate numerous other messages sent between the CCC and the ECUs. It will also be apparent to those skilled in the art that the basic format of the CCC/ECU messages may be changed.

E. Data Processor Operation

The operation of the Data Processor will now be described for an embodiment of the invention using the message formats and messages illustrated in Figures 10-17. A source and object code computer program listing which will be readily understood by those skilled in the art for controlling the operation of the Data Processor is annexed at Appendix C.

Figure 18a illustrates the overall programmed operation of the Data Processor. As shown in Figure 18a, data received from the CCC is placed by USART 400 of digital unit 55 (Figure 5) in FIFO receive buffer 1001. This buffer is organized as a 256 x 4 byte buffer such that it can hold up to four 256-byte CCC messages at any one time. A buffer counter associated with the Data Processor points to the next empty buffer in the FIFO. Two other buffers shown in Figure 18a are FIFO output buffer 1002 and FIFO input buffer 1003. Data received by the Data Processor from the Drop Processor is placed in output buffer 1002. Similarly, data passed to the Drop Processor from the Data Processor is placed in FIFO input buffer 1003. Each of these buffers contains 256 bytes and may buffer up to 25 10-byte messages. A buffer counter associated with each buffer points to the next empty buffer. The Data Processor receives data from FIFO buffers 1001 and 1002, operates on the data (Figure 18a, item 1004), and sends data to FIFO buffer 1003 or to the CCC.

Figure 18b illustrates a flow chart of a routine by which the Data Processor determines whether or not a message has been received from the CCC and, if so, whether or not the message is for that ECU. The routine of Figure 18b is called whenever the Data Processor is interrupted by USART 400 (Figure 5) to signify that a message has been received from the CCC.

The routine of Figure 18b commences at step 1021, where the routine inhibits further input from USART 400 and determines from the CRC bytes of the received message whether or not a transmission error occurred. If an error occurred, the routine branches to step 1028 where input from USART 400 is again enabled. After step 1028, the interrupt service routine advances to step 1029 and returns to the calling program.

Alternatively at step 1021, if no transmission error occurred, the routine advances to step 1022 where the Data Processor checks the address bytes of the received message. If the address bytes match the ECU's address, the routine advances to step 1027 where the buffer counter associated with FIFO buffer 1001 (Figure 18a) is incremented by one. The routine then advances to step 1028 where USART 400 is enabled as earlier described. Because the buffer counter value was incremented at step 1027, a subsequent CCC message received by USART 400 will be written into the next buffer and will not overwrite the contents of the buffer containing the previously received CCC message.

Returning to step 1022, if the address bytes of the received message do not match the ECU's address, the routine branches to step 1024, where the address bytes are checked for the presence of the global or broadcast address (hex FFFF). If this address is present, the message is for the ECU and the routine advances to step 1027 as previously described. Otherwise, the routine advances to step 1025 where the Data Processor checks for the mask address (hex 0000) in the CCC's message. If this address is not present, the message is not for the ECU and the routine branches to step 1028. Otherwise, the routine advances to step 1026 where the mask operation is performed as earlier described.

The routine then branches to step 1027 or to step 1028 depending respectively on whether or not the result of the mask operation performed at step 1026 indicates that the message is for the ECU.

The operating program of the Data Processor will now be described with reference to Figures 18c through 18h. This program is comprised of two major parts: (1) a main routine, and (2) a collection of application programs to implement various functions within the ECU. The main routine is a task-driven program which branches to one or another application program depending upon the task to be performed. The application program performs its task (e.g., inputting keypress data from an SPU such as subscriber-entered channel requests, pay-per-view requests, send function data, etc.) and returns to the main routine. Because of the need to service a plurality of SPUs on a plurality of drop cables, it may occur that an application program must return to the main routine before the application program has completed its particular task. For example, if a subscriber enters a two-digit channel request into an SPU keyboard, the application program associated with that function may input the first digit and return to the main routine prior to the subscriber entering the second digit. In this event, the application program prior to returning to the main routine sets a time out value in a time table and a jump address in a jump address table. As more fully described below, the time out and jump address values enable the main routine to jump back to the application program at the appropriate time to continue at the point the application program left off.

Figure 18c illustrates a flow chart generally illustrating the operation of the main routine. As shown in Figure 18c, the main routine begins at

step 1005 upon ECU power up. At step 1005, the Data Processor initializes I/O and memory maps, an interrupt timer, direct memory access, and various registers and counters. The program then advances to step 1006, where the Data Processor initializes USART 400. At step 1007, the Data Processor 420 checks whether or not its back up memory requires initializing. If so, the program advances to step 1008 to initialize the back up memory. Otherwise, or after completing the back up memory initialization in step 1008, the program advances to step 1009 where other memory locations are initialized. Generally, steps 1008 and 1009 initialize such items as the Channel Authorization Map, Channelization Map, parental control codes, Program Event Map, Program Authorization Map, and so forth. In steps 1010, 1011 and 1012, the Data Processor initializes the drop and device polling maps and pointers.

After initialization, the Drop Processor enters a main loop. The main loop is illustrated in the flow chart of Figure 18d. As shown in Figure 18d, the Data Processor in the main loop sequentially determines whether or not any of four events have occurred, viz., whether or not (1) the Data Processor has received a message from the CCC (step 1013), (2) a 100/64 millisecond pay-per-view event timer has timed out (step 1014), (3) the Drop Processor output buffer contains data for the Data Processor (step 1015), and (4) a pay-for-view event timer has timed out (step 1016). If any of the foregoing events have occurred, the Data Processor at the appropriate step 1013, 1014, 1015 or 1016 branches to an associated operation routine shown in Figure 18d as Operate 1, Operate 2, Operate 3 and Operate 4, respectively. Otherwise, the program advances to the next numbered step in Figure 18d. After step



1016, or after an operation routine, the program flow loops to step 1013.

The operation routines of Figure 18d will now be described with reference to Figures 18e-18h.

#### Operate 1 Routine

If the main routine detects at step 1013 (Figure 18d) that a message addressed to the ECU has been received from the CCC, the program branches to the Operate 1 routine, shown in Figure 18e, to respond to the CCC message.

The Operate 1 routine commences at step 1030, where the Data Processor loads a CCC message from buffer 1001 (Figure 18a) into working memory. The program then advances to step 1031, where the COMMAND byte of the CCC message is checked to determine what action the Data Processor should take.

At step 1031, if the COMMAND byte of the CCC message is hex F0-F3 (ECHO BACK), the program advances to step 1032 to transmit (echo) the received message back to the CCC. After transmitting the message, the program advances to step 1041 and returns to the main loop as earlier described.

If the COMMAND byte at step 1031 is hex FC (WRITE), the program advances to step 1033 to store the data contained in the WRITE message commencing at the location of the ECU's memory. From step 1033, the program advances to step 1034 and returns to the main loop as earlier described.

If the COMMAND byte at step 1031 is hex F8-FB (READ), the program advances to step 1035 to transmit to the CCC data from the ECU's memory specified in the WRITE message. From step 1035, the program advances to step 1043 and returns to the main loop as earlier described.

If the COMMAND byte at step 1031 is hex F4 (FORCE TUNE), the program advances to step 1037 where

the converter of the specified SU is tuned to the specified channel, the SPU seven-segment display is set to display the logical channel to which the SU is being force tuned, and the power relay of the SPU associated with the SU is activated to turn on the subscriber's television. The program then advances to step 1038 and returns to the main loop as earlier described.

If the COMMAND byte at step 1031 is hex 80 (SEND FUNCTION ENABLE) or hex 81 (SEND FUNCTION CLEAR), the program advances respectively to step 1039 to enable/disable the send function in the SPU's or to step 1042 to clear the send function data buffer in the ECU. From steps 1039 or 1042, the program advances respectively to step 1040 or step 1043 and returns to to the main loop as earlier described.

If the COMMAND byte at step 1031 is hex 84-87 (SEND FUNCTION DATA), the program advances to step 1044 where the Data Processor checks the value of the send function data count byte to determine whether or not the ECU has any send function data to return to the CCC. If the ECU has no send function data, the program branches from step 1044 to step 1047 and returns to the main loop as earlier described. Otherwise, the program advances to step 1045 where the ECU's send function data is transmitted to the CCC. The program then advances to step 1046 and returns to the main loop as earlier described.

Finally, if the COMMAND byte at step 1031 is hex 88 (PAY-PER-VIEW), the program branches to step 1048 where the MS tuning data contained in the PAY-PER-VIEW message is stored in the ECU's Program Event Map. The program then advances to step 1049 where the Data Processor checks the Program Authorization Map to determine for a first subscriber whether or not the subscriber has ordered to view the pay-

per-view program. If a subscriber has requested to view the pay-per-view event, the program advances to step 1050 where the SU associated with that subscriber is force tuned to the pay-per-view program, the associated five-minute preview timer is started, the event-order LED on the subscriber's SPU is set to flashing, and the SPU's power relay is activated to turn on the subscriber's television. The program then advances to step 1051 which causes the program to loop back to step 1049 for each of up to six subscribers. After looping for all subscribers, the program from step 1051 advances to step 1052 and returns to the main loop as earlier described.

#### Operate 2 Routine

If the main routine detects at step 1014 (Figure 18d) that the 100/64-second timer has timed out, the program branches to the Operate 2 routine, shown in Figure 18f. The Operate 2 routine functions to transfer control of the Data Processor to any of a plurality of application programs. As earlier described, application programs implement a variety of functions, such as responding to SPU key presses and implementing the requested operation (e.g., channel selection pay-per-view, parental control), activating the SPU's power relay, activating (flashing or non-flashing) and deactivating the SPU order event LED, clearing the SPU seven-segment display, sending data (e.g., program or channel information) to the SPU display, and so forth.

The Operate 2 program operates as follows. The Data Processor maintains in memory a time table having a plurality of two-byte entries for each of up to 8 devices on each of up to 6 different drops associated with the ECU. In one embodiment, the time table has 64 entries (0-63), although in the

described embodiment there may be no more than 6 drops with no more than 8 devices (up to 4 SPUs and up to 4 other devices) on each drop associated with each ECU. The entries in the time table are sequentially arranged by drop and device, such that entries 0-7 are associated with devices having addresses 0-7 on drop 0, entries 8-15 are associated with devices having addresses 0-7 on drop 1, and so on. As previously described, the entries in the time table are set by the various application programs as a time out value prior to a return to the main routine from the application program.

Upon entry into the Operate 2 routine, a time table pointer (I) is set to a value from 0-63 (step 1060) as a function of the value of a time table counter (J). The routine then advances to step 1061, where the I pointer is used to read the I<sup>th</sup> entry (associated with a particular device on a particular drop as described above) from the time table. If the value of that entry is hex FFFF (signifying that the timer is off), the routine branches to step 1066 where the time table counter J is incremented by one in preparation for the next pass through the Operate 2 routine. If the entry is other than hex FFFF, the routine advances to step 1062 where the time table entry is decremented by one. If the time table value after decrementing is not equal to zero (step 1063), the routine branches to step 1066 where the J counter is incremented as previously described.

On the other hand, if the timer entry is equal to zero, the timer has timed out and the routine advances to step 1064 where a zero is placed in a memory location (Key Code), and the value of the I pointer is used to interrogate a jump table. The jump table is a table maintained in the ECU's memory which is similar in organization to the time

table. However, the jump table entries specify the memory location in an application program to which the program should jump. These values may point to the start of an application program, or to a point within an application program if the application program had previously returned to the main routine prior to completing the application program's task. Based upon the entry contained in the jump table, the Operate 2 routine then advances to step 1065, where the routine jumps to the point in an application program ("APL") specified by the jump table. When the application program returns to the Operate 2 routine, the Operate 2 routine advances to step 1066 where the J counter is incremented as earlier described. The routine then advances to step 1067 to return to the main loop.

#### Operate 3 Routine

If the main routine determines at step 1015 (Figure 18d) that the Drop Processor has data for the Data Processor, the program branches to the Operate 3 routine, shown in Figure 18g. The Operate 3 routine functions to appropriately respond to data received from the Drop Processor. Such data may include 84 Commands (Unsolicited Data Responses), and 04 Responses received from associated SPUs.

As shown in Figure 18g, the Operate 3 routine at step 1070 first determines what type of message is being sent from the Drop processor. If the message is an 01, 03, 05, 07 or 08 command response (earlier described), no action is required and the Operate 3 routine advances to step 1083 to return to the main routine as earlier described. Although in the flow chart of Figure 18g no action is taken in response to an 01, 03, 05, 07 or 08 response, it will be apparent to those skilled in the art that various

modifications may readily be made to the program flow to cause the Data Processor to respond to any or all of these command responses. For example, the program may be modified to cause the Data Processor upon detecting in an 01 response that power is not being received from a particular drop to notify the system operator of this fact.

If an 84 Command is detected at step 1070, the Operate 3 program branches to step 1072 to determine if an error has occurred. If "yes", the program branches to step 1073 where a device error counter is incremented in an error operation subroutine. If the counter reaches a predetermined value (e.g., 2), the error subroutine causes a re-initialization of pointers and jump table entries associated with the SPU or device sending the 84 Command. The program then advances to step 1083 to return to the main loop as earlier described. On the other hand, if no error is detected at step 1072, the program advances to (1) step 1074, where the jump table pointer is set, (2) step 1075, where the received data is placed in a memory location (Key Code), and (3) step 1076, where the program jumps via the jump table to the appropriate application program (APL). When the application program returns to the Operate 3 routine, the Operate 3 routine advances to step 1083 and returns to the main loop.

Finally, if an 04 Response is detected at step 1070, the Operate 3 routine advances to step 1071 to check for a transmission error. If an error has occurred, the routine branches to step 1073. Otherwise, the routine advances to step 1077 where the Data Processor determines if the 04 Response is a status response. If the 04 Response is not a status response, the program branches from step 1077 to step 1083 to return to the main loop as earlier

described. Otherwise, the program advances to step 1078. At step 1078, if the status response indicates that a key has been recently depressed on the device keyboard, the routine branches to steps 1080, 1081 and 1082 to respond to the key press as described above with respect to steps 1074-1076. If the status response indicates that no key has been recently depressed, the program advances from step 1078 to step 1079 where the status byte is checked to determine the state of bit 7. As earlier described, bit 7 indicates as a function of the setting of SPU switch 780 (Figure 7) whether the responding device is a master or slave SPU and, thus, to which converter (primary or secondary) the SPU is assigned. After step 1079, the program advances to step 1083 to return to the main loop as earlier described.

#### Operate 4 Routine

Lastly, if the main routine at step 1016 (Figure 18d) determines that the pay-per-view timer has timed out, the program branches to the Operate 4 routine shown in Figure 18h. This routine starts by entering a loop at step 1091 to determine for each subscriber whether or not the subscriber is viewing a pay-per-view program. If the subscriber is not viewing a pay-per-view program at step 1091, the routine branches to step 1096 where the routine loops back to step 1091 to make the foregoing determination for the next subscriber. If at step 1091 a pay-per-view event is being viewed by a subscriber, the routine advances to step 1092 to check the associated 5-bit preview timer in the appropriate byte of the Program Authorization Map. If the value of the byte is greater than or equal to F8, indicating that the byte's five most significant bits (i.e., the timer bits) are all set to "1" and the preview period has

expired, the program branches to step 1096. However, if the value of the byte is less than hex F8, indicating that at least one of bits 3-7 of the byte is equal to zero and the preview period has not expired, then the program advances to step 1093 where the 5-minute timer is incremented by setting a timer bit to "1". The routine then advances to step 1094, where the value of the byte is again checked. If the five timer bits are now all set to "1", then the preview period has expired and the program branches to step 1095 to cause the order-event LED on the subscriber's SPU to glow steadily to indicate that the subscriber will be charged for the pay-per-view event. Otherwise, the program branches to step 1096. Step 1096 causes the routine to loop to step 1091 to check for each subscriber whether or not a pay-for-view event is being viewed. At step 1096, after the routine has determined for each subscriber whether or not the subscriber is reviewing a pay-per-view event, the routine advances to step 1097 and returns to the main loop as earlier described.

#### F. Polling and Handshaking

In the above-described system, an ECU transmits a message to the CCC only if the ECU receives a CCC message which requires a return message (e.g., READ, ECHO BACK or SEND FUNCTION DATA messages). Otherwise, ECUs do not transmit messages to the CCC.

Thus, in the above-described system, it is possible for an ECU to have important information to send to the CCC (e.g., information received from a subscriber requesting additional services, or information from a medical monitoring device attached to the drop cable of an ECU), but be unable to notify the CCC of this fact. Also, because ECUs in the above-described system do not ordinarily respond to



the CCC upon receipt of a CCC message, the CCC might not become alerted to an inoperative ECU or transmission link until a message requiring a response (e.g., READ) was addressed to the ECU and the responsive message was not received by the CCC.

To enable ECUs to send important information to the CCC in a timely fashion, and to provide for a check that ECUs are operative, a polling and handshaking communication protocol may be used. In view of the potential for a large number of ECUs (up to 65,536 on each of up to 4 banks) on the cable network of the present invention, an important consideration in designing such a protocol is to minimize the time required to poll and handshake with individual ECUs.

The present invention therefore provides for a handshaking scheme which informs the CCC of inoperative ECUs but which does not require the transmission of relatively lengthy formatted messages. In addition, the present invention provides for a polling scheme which allows an ECU to notify the CCC that the ECU has information for the CCC, but does not require the transmission of lengthy information messages to the CCC in response to the receipt by an ECU of a poll message. The polling scheme enables the CCC to gather information from the ECUs via two independently operating mechanisms. A first or "general" polling scheme allows the CCC to poll each ECU to determine if the ECU has information to send to the CCC. The general polling scheme allows for the detection in less than 20 seconds of all operative ECUs which require service. A second or "priority" polling scheme allows for the detection in less than 20 milliseconds of any one ECU having so-called priority information for the CCC. For both polling schemes, the response "level" is established by the CCC in advance of the poll to identify

and obtain responses from only those ECUs having information falling within a predetermined level or threshold of importance. The level of information may be a function, e.g., of the value or timeliness of the information.

#### 1. Message Format

The polling and handshaking protocols are described below with respect to an alternative basic message format from that earlier described and shown in Figures 10-11. This alternative basic message format is illustrated in Figures 19-20.

Figure 19 shows an alternative basic message format for data communication in the forward direction (i.e., from the CCC to an ECU). Each message is of a predetermined format, comprising: a FLAG byte, a SEND CONTROL ("SEND CNTL") byte, a plurality of DATA bytes, two CYCLIC REDUNDANCY CHECK ("CRC") bytes, and another FLAG byte. Each byte is comprised of 8 bits. The FLAG and CRC bytes are identical to and serve the same function as the FLAG and CRC bytes previously described.

The SEND CNTL byte in the message of Figure 19 is used to define any of 256 unique commands. As described in greater detail below, SEND CNTL commands may cause an ECU to return information to the CCC, or may cause the ECU to perform a specified operation.

The DATA bytes may comprise from 0 to 255 bytes per message. The SEND CNTL byte specifies how the DATA bytes are to be interpreted by the ECU. If a message is transmitted to a particular ECU, the first two DATA bytes typically specify the ECU address from 0-65536. The first address byte ("ADL") specifies the low-order part of the address, and the second byte ("ADH") specifies the high-order part. Also,

typically, the third DATA byte of a message addressed to a particular ECU is a CONTROL ("CTL") byte. The CTL byte may specify the ECU drop, if any, for which the message is designated, the particular reverse channel that the ECU should use to respond to the CCC, etc.

An alternative basic message format in the reverse direction (i.e., from the ECUs to the CCC) is shown in Figure 20, and is similar to the format for forward communication. Thus, FLAG bytes are used to identify the beginning and end of a message. Following the beginning FLAG byte is a RECEIVE CONTROL ("REC CNTL") byte. The REC CNTL byte, which need not be identical to the SEND CNTL byte, specifies how subsequent DATA bytes, if any, contained in the message are to be interpreted by the CCC. Two CRC bytes, earlier described, follow the last DATA byte.

In addition to the foregoing basic messages, special ECU poll response bytes are utilized. These poll response bytes are comprised of one or two byte-times of carrier from an ECU. As described below, these poll response bytes are used as a handshake in response to polling and informational messages sent from the CCC.

## 2. General Level Polling Protocol

The first polling method is the so-called General Level Request ("GLR") poll. This mechanism is used to sequentially address a poll message to each ECU in the system to determine whether or not the ECU requires service (i.e., whether or not the ECU has information for the CCC). Prior to the poll, the CCC establishes the "level" at which the ECUs will respond to the poll. Once the CCC has established the poll level, an ECU responds to a GLR poll only if the ECU (a) requires service, and

(b) has information to transmit to the head end 12 which is at a level equal to or less (i.e., more important) than the level previously established by the CCC. The addressed ECU upon receipt of a GLR poll responds by sending to the CCC one or two General Poll Response ("GPR") bytes. Each GPR byte consists of one byte-time of carrier from the ECU, or "11111111". If the CCC fails to detect a GPR byte from the polled ECU within a predetermined time interval (e.g., 350 microseconds), the CCC presumes the ECU to be inoperative. After a predetermined number of (e.g., five) unsuccessful attempts to contact the ECU, the CCC prints an appropriate error message to the head end operator.

If the addressed ECU transmits to the CCC a single GPR byte in response to a GLR poll, the CCC interprets this to mean that the ECU is operative and does not require servicing. The CCC then polls the ECU having the next sequential address. However, if the ECU returns two GPR bytes, the CCC interprets the response as a service request from an operative ECU. Using the GLR poll, the CCC periodically cycles through all active ECUs and constructs a Service Request table in memory. The CCC subsequently uses this table to selectively retrieve, using a Priority Information Request message later described, information from only those ECUs requiring service. At a forward data transmission rate of 200 Kbps, a complete general poll request cycle of 65,536 ECUs typically takes less than 20 seconds.

The GLR poll is implemented by the CCC as follows. First, the CCC transmits a General Level Request Threshold ("GLRT") message. A typical GLRT message is shown in Figure 21a in accordance with the basic message format of Figure 19. The GLRT message has a SEND CNTL byte equal to 08 and is used

by the CCC to establish the response threshold level for the GLR poll, as earlier described. The response threshold is established by a level ("LVL") byte contained within the GLRT message. The first two bits of the CTL byte of the GLRT message specify how the ECU should interpret the LVL byte. If the first two bits of the CTL byte are "01", this is interpreted by the ECU to mean that the ECU should respond positively (i.e., with two GPR bytes) to subsequent poll messages only if the level of the ECU's information is equal to the level set forth in the LVL byte. If the first two CTL byte bits are "10", this means the the ECU should respond positively to poll messages if the level of information to be sent to the CCC is equal to or less than the LVL value.

After sending the GLRT message to establish the poll level, the CCC transmits one or more General Level Request Poll ("GLRP") messages. A typical GLRP message is illustrated in Figure 21b in accordance with the basic message format of Figure 19. As shown in Figure 21b, the SEND CNTL byte of a GLRP message may be any value equal to 0, 1, 2, or 3. The SEND CNTL byte of the message specifies to the addressed ECU that the message is a GLRP message, and further specifies on which reverse channel (0, 1, 2, or 3) the ECU should send GPR response bytes. If an ECU responds to the GLRP message with two GPR bytes on the specified reverse channel, this is interpreted by the CCC as a service request from an operative ECU as earlier described. If one GPR byte is returned, this is interpreted by the CCC as a response from an operative ECU not requiring service. If no GPR bytes are received, the CCC presumes the ECU to be inoperative.

### 3. Priority Polling Protocol

The second or priority polling method is the so-called Priority Information Window ("PIW") poll. This second method establishes a priority "window" on the cable network such that any ECU having information to send to the head end which falls within the pre-established priority window will alert the head end of this fact on a predetermined priority service request channel in response to the receipt of any general polling request addressed to any ECU.

Priority polling is enabled by a Priority Information Request Window Control ("PIRWC") message sent from the CCC. The PIRWC message, illustrated in Figure 22a in accordance with the format of Figure 19, is used by the CCC to set the ECU priority response threshold level. As shown in Figure 22a, a PIRWC message has a SEND CNTL byte equal to 9. A LVL byte of the PIRWC message specifies the priority response threshold level. The ECU interprets the LVL byte in a manner determined by the value of the bits in a control ("CTL") byte. Bits 0 and 1 of the CTL byte specify whether the ECU should respond if the level of its information is equal to the value of the LVL byte, or whether the ECU should respond if its level of information is equal to or less than the LVL value. In addition, bit 2 of the CTL byte specifies whether to turn the PIW function in the ECU on or off. Finally, bits 3 and 4 of the CTL byte specify on which of the four reverse channels the ECU should return a priority response. The values and functions of the bits of the CTL byte in one embodiment of the PIRWC message are set forth below:

TABLE EPIRWC CTL BYTE

<u>B1</u>	<u>B0</u>	<u>Function</u>
0	1	The ECU should respond to a priority poll only if the level of its information equals the value of LVL.
1	0	The ECU should respond to a priority poll only if the level of its information is equal to or less than the value of LVL.
<u>B2</u>		<u>Function</u>
0		Set PIW in ECU off.
1		Set PIW in ECU on.
<u>B4</u>	<u>B3</u>	<u>Function</u>
0	0	Return priority response on reverse channel 0.
0	1	Return priority response on reverse channel 1.

After a PIRWC message is transmitted to and received by the ECUs, any ECU with priority information corresponding to the threshold level established by the PIRWC message will transmit to the CCC on the specified priority reverse channel a general poll response (GPR) byte after reception of any general level poll message. The reception by the CCC on the priority reverse channel of a GPR byte (there may be more than one response from a plurality of ECUs) alerts the CCC that an ECU (the identity of which is as yet unknown to the CCC) has priority information to send. Upon receipt of such a priority response, the CCC transmits a series of

messages, described below, to disable the priority "window" and to locate within 20 milliseconds an ECU sending the priority poll response.

Assuming for the moment that the CCC has identified an ECU returning a priority response (or requesting service in response to the earlier described GLR poll), the CCC obtains the information from the identified ECU by addressing a Priority Information Request ("PIR") message to the ECU. There are four PIR messages: PIR0, PIR1, PIR2, and PIR3, having SEND CNTL bytes equal to 4, 5, 6, and 7 respectively (Figure 22b). The PIR0, PIR1, PIR2 and PIR3 messages cause the ECU to send its priority information to the CCC on reverse channels 0, 1, 2, or 3, respectively.

In response to a PIR message, the addressed ECU transmits its priority information to the CCC using a Priority Information Request Response ("PIRR") message. The PIRR message allows an ECU to send to the CCC any of 256 different messages or values of numeric data for each drop associated with the ECU. A typical PIRR message is illustrated in Figure 22c in accordance with the format of Figure 20.

As shown in Figure 22c, a PIRR message includes a REC CNTL byte equal to 0. A LEVEL ("LVL") byte specifies the threshold level assigned to the priority information which the ECU is transmitting to the CCC (the LVL byte will either match the level previously established, or be numerically less than that level, depending upon the information contained in the previously sent PIRWC message). Following the LVL byte is a CONTROL ("CTL") byte. The CTL byte specifies by the setting of bits 0-5 the drop or drops to which the priority information contained in the message relates. Each bit position 0-5 in the CTL byte is associated with a different ECU drop. For each drop as to which the ECU is sending priority



information, the ECU sets to "1" the corresponding bit in the CTL byte. Following the CTL byte are up to 6 bytes of data (Dn), each byte representing a predetermined or "canned" priority message or numeric value with respect to a different one of the 6 drops associated with the ECU and specified in the CTL byte. The message concludes with the usual CRC and FLAG bytes.

Various divisions and definitions may be used for establishing the different levels of ECU priority information. For example, levels 0-7 may be associated with medical information obtained from medical monitoring devices attached to an ECU drop cable. Similarly, levels 16-23 may be associated with security information obtained from security devices attached to an ECU drop. Lower levels, such as levels 32-39, may be used by an ECU to inform the CCC of syntax or other errors contained in CCC messages received by the ECU. Similarly, information such as ECU status information, subscriber requests for additional services, subscriber responses to interactive two-way services, and other information may be associated with other priority levels.

The manner in which the CCC identifies an unknown ECU responding with a priority service request will now be described.

The CCC identifies an unknown ECU having priority information for the CCC using a binary sort method. The binary sort method involves dividing the population of ECUs having sequential addresses in the range of 0 to n into first and second groups of ECUs having respectively a first group address range from 0 to  $n/2$ , and a second group address range from  $n/2 + 1$  to n. The CCC then transmits a message to the first group to determine whether or not any ECUs in the first group have priority information. If the first group includes an ECU (still unknown)

having priority information, the CCC subdivides the first group into third and fourth groups in the manner earlier described, and sends a message directed now to the third group to determine whether or not any ECUs in the third group have priority information to send. If the third group includes an ECU having priority information, the CCC subdivides the third group into fifth and sixth groups and repeats the foregoing process. If the CCC at any time determines that the group (first, third, fifth, etc.) with which it is working does not have priority information, the CCC knows that the other respective group (second, fourth, sixth, etc.) must contain the ECU having the priority information. The CCC then transmits messages to and repetitively subdivides that group until, eventually, the CCC subdivides a group to a single ECU having priority information. As will be apparent to those skilled in the art, the foregoing binary sort method in the case of 65,536 ( $2^{16}$ ) ECUs requires no more than 16 iterations to locate an ECU having priority information.

The messages used by the CCC in implementation of the binary sort method in an embodiment of the invention are shown in Figures 23a-d.

The CCC initiates a search for an unknown ECU having priority information using a Binary Sort Initialization ("BSI") message, shown in Figure 23a. The BSI message has a SEND CNTL byte equal to 10, followed by two bytes specifying (in low and high order parts) a binary sort high address ("BSHAL" and "BSHAH") and two bytes specifying (in low and high order parts) a binary sort low address ("BSLAL" and "BSLAH"). The BSI message is sent by the CCC following receipt of a GPR byte on the priority information reverse channel. The BSI message is used by the CCC to turn the priority information window off, to specify the binary sort group high address, and

to specify the binary sort group low address. No response to the BSI message is expected from any ECU.

After the binary sort is initialized with the BSI message, the CCC transmits a series of binary sort poll messages to locate an ECU having priority information to send. Each binary sort poll message turns the priority information window off and specifies a binary sort group address range. Upon receipt of a binary sort poll message, any ECU having priority information within the priority information threshold level and an address within the specified group address range responds by transmitting to the CCC a GPR byte on the priority information channel previously established by the CCC. Three binary sort poll messages, shown in Figures 23b-23d, are utilized in one embodiment of the invention to define the binary sort group range.

Figure 23b shows a Binary Sort Poll High and Low ("BSPHL") message. This message is used by the CCC to specify a binary sort group address range bounded between a low address and a high address. The BSPHL message has a SEND CNTL byte equal to 11. Following the SEND CNTL byte are two bytes specifying the binary sort high address ("BSHAL" and "BSHAH"), and two bytes specifying the binary sort low address ("BSLAL" and "BSLAH"). Any ECU having priority information within the priority information threshold level and having an address within the low and high group address range specified in the BSPHL message responds to the CCC by transmitting a GPR byte on the priority information reverse channel.

Figure 23c shows a Binary Sort Poll Low ("BSPL") message. The BSPL message, having a SEND CNTL byte equal to 12, is similar to the BSPHL message except that the BSPL message specifies only a binary sort low group address ("BSLAL" and "BSLAH"). This

message is used by the CCC to subdivide a group address range by modifying only the low address of the group range. The BSPL thus enables the CCC to subdivide a group address range without having to send both the low and high addresses of the range. Any ECU having priority information within the priority information threshold level and having an address which is greater than or equal to the specified group low address of the BSPL message and less than or equal to the previously specified high group address responds to the CCC by transmitting a GPR byte on the priority information reverse channel.

Finally, Figure 23d shows a Binary Sort Poll High ("BSPH") message. The BSPH message includes a SEND CNTL byte equal to 13. In this message, two bytes specify a binary sort group high address ("BSHAL" and "BSHAH"). This message is used similarly to the BSPL message to subdivide a group by modifying only one (i.e., the high) group address. Any ECU having priority information within the priority information threshold level and having an address which is less than or equal to the group high address of the BSPH message and greater than or equal to the previously specified low group address responds to the CCC by transmitting a GPR byte on the priority information reverse channel.

#### 4. Information Protocol

When information, rather than a poll or status request, is transmitted from the CCC to an ECU, an informational protocol including a handshaking sequence is used to provide the CCC with positive feedback that (a) the ECU received the message, (b) the message syntax was proper, (c) there were no transmission errors, and (d) the ECUs are operative. The handshaking sequence does not require the trans-

mission of lengthy formatted messages, thus minimizing the amount of time required to handshake with the CCC.

The handshaking response to informational messages is a General Poll Response Verification ("GPRV"), comprising one or two bytes of "11111111". If no GPRV is detected by the CCC, the CCC interprets this to mean that the ECU is inoperative. If a single byte is received, the CCC interprets this to mean that the message was not accepted by the ECU. If two bytes are received, the CCC interprets this to mean that the message was received by the ECU without error and that processing will occur. If a two-byte response is not received, the CCC will try a predetermined number of times (e.g., five) before logging and notifying the operator of an error.

While preferred embodiments of the invention have been set forth for purposes of the disclosure, modification to the disclosed embodiments may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all embodiments of the invention and modifications to the disclosed embodiments which do not depart from the spirit and scope of the invention.

LOC	OBJ	LINE	SOURCE STATEMENT
1			
2			
3			main.asm V1.0
4			(TMP4740P)
5			
6			main routine
7			
8			
9			

snolist

slist

306 ;

ROM PAGE NO.15

03E0	307	org	h'300	
	308 ;			
	309 ;			
	310 ; initialize			
	311 ;			
03E0 3600	312 main:	dclr	11,0	
	313 ;			
	314 ; ram clear			
	315 ;			
03E2 C0	316	ld	h,2h'0	
03E3 E0	317	ld	l,2h'0	
03E4 10	318	mov	h,a	
	319 ;			
03E5 1A	320 main:	st	a,0h1+	
03E6 A5	321	b	main	
	322 ;			
03E7 38C1	323	add	h,2h'1	
03E9 A5	324	b	main	
	325 ;			
	326 ; in / out port initialize			
	327 ;			
03EA 3A89	328	out	a,xop19	; divider reset
03EC 3A8C	329	out	a,xop1c	; counter1 reset
03EE 3A8D	330	out	a,xop1d	; counter2 reset
	331 ;			
03F0 4F	332	ld	a,2h'f	
03F1 3AA1	333	out	a,xop01	; led display.
03F3 3AA2	334	out	a,xop02	; led display
03F5 3AA4	335	out	a,xop04	; relay, keyscan out
03F7 3AA5	336	out	a,xop05	; keyscan out
03F9 3AA6	337	out	a,xop06	; led driver, vlfout
03FB 3AA7	338	out	a,xop07	; keyscan in
03FD 3AA8	339	out	a,xop08	; interrupts

LOC	OBJ	LINE	SOURCE STATEMENT
03FF	3A89	340	out a,xop09 ; no use
		341	;
		342	stack pointer word initialize
		343	;
ROM PAGE NO.16 *			
0401	4C	344	ld a,2h'c
0402	3FFF	345	st a,spw
		346	;
0404	4A	347	ld a,2h'a
0405	3FCA	348	st a,rwpch ; address h'a00
		349	;
		350	led data set
		351	;
0407	4F	352	ld a,2h'f
0408	3F35	353	st a,ldatm1
040A	3F39	354	st a,ldasm1
		355	;
040C	4B	356	ld a,2h'b
040D	3F36	357	st a,ldatm2
040F	3F3A	358	st a,ldasm2
		359	;
0411	4F	360	ld a,2h'f
0412	3F37	361	st a,ldat11
0414	3F3B	362	st a,ldas11
		363	;
0416	4B	364	ld a,2h'b
0417	3F38	365	st a,ldat12
0419	3F3C	366	st a,ldas12
		367	;
041B	4F	368	ld a,2h'f
041C	3F8D	369	st a,lecot1
041E	3F8E	370	st a,lecotm
0420	3F8F	371	st a,lecotb
		372	;
		373	key data set
		374	;
0422	4F	375	ld a,2h'f
0423	3F2B	376	st a,keyod
0425	3F42	377	st a,kest01
0427	3F43	378	st a,kest0h
		379	;
		380	interrupts register initialize
		381	;
0429	47	382	ld a,2h'7
		383	;
042A	3A89	384	out a,xop19 ; divider start
		385	;
042C	3F1C	386	st a,sirb
042E	13	387	xch a,sir ; isio inhibit
		388	;
		389	;
		390	framing error bit on
		391	;

LOC	OBJ	LINE	SOURCE STATEMENT	
042F	3931	392	set spuvum,3	; framing error
		393 ;		
		394 ;	timer on 11 bit time	
		395 ;		
0431	3B44	396	clr %op04,0	; timer clock start
		397 ;		
0433	4F	398	ld a,2h'f	
0434	3FF6	399	st a,timrhn	
0436	47	400	ld a,2h'7	
0437	3FF3	401	st a,timrhn	
0439	4C	402	ld a,2h'c	
043A	3FF4	403	st a,timrln	
		404 ;		
043C	44	405	ld a,2h'4	
043D	3A8C	406	out a,%op1c	; start
		407 ;		
		408 ;		
		409 ;	enable interrupts	
		410 ;		
043F	3648	411	seclr 11,0	
		412 ;		
		413 ;		
		414 ;	recent power on	
		415 ;	& converter selection	
		416 ;		
ROM PAGE NO.17 *				
0441	3922	417	set spus1,2	; spu status hi
		418 ;		
0443	391F	419	set servrc,1	; service request
		420 ;		
0445	3B04	421	test %op04,2	
0447	8B	422	b mai00	
		423 ;		
0448	3933	424	set spush,3	; hi channel converter
044A	8D	425	b mail	
		426 ;		
044B	3973	427 mai00:	clr spush,3	; lo channel converter
		428 ;		
		429 ;		
		430 ;	10 sec bit 'on' ?	
		431 ;		
		432 ;		
044D	39E4	433 mail:	testp spuvdm,2	
044F	8D	434	b mail	; 10 sec bit on
		435 ;		
		436 ;		
		437 ;	command execute bit 'on'	
		438 ;		
		439 ;		
0450	39F4	440 mai20:	testp spuvdm,3	
0452	A9	441	b mai2	; execute 'command'
		442 ;		
		443 ;		



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LOC	OBJ	LINE	SOURCE STATEMENT
		444	; keyscan ?
		445	;
		446	;
0453	39E5	447	mai4: testp spuvs1,2
0455	65DD	448	b mai3 ; keyscan ready
		449	;
		450	;
		451	; cry enable ?
		452	;
		453	;
0457	39F1	454	mai5: testp spuvs,3
0459	A8	455	b mai6
		456	;
045A	3984	457	test spuvs,0
045C	8D	458	b mai1 ; cry enable
		459	;
045D	2E0F	460	cmpr servrc,2h'0
045F	A3	461	b mai6
		462	;
0460	3B36	463	mai6: set %op06,3
0462	8D	464	b mai1
		465	;
0463	3B76	466	mai6: clr %op06,3
		467	;
0465	3984	468	test spuvs,0
0467	A8	469	b mai6
		470	;
0468	8D	471	b mai1
		472	;
		473	;
		474	;
		475	; command execute
		476	;
		477	;
0469	3C15	478	mai2: ld a,comma
046B	D2	479	cmpr a,2h'2
046C	65D9	480	b core ; not implied comma
rd		481	;
046E	3C14	482	ld a,comma
		483	;
0470	5F	484	test a,3
0471	64F5	485	b core
		486	;
		487	; command '08' - '0f'
		488	;
0473	D9	489	cmpr a,21001b
0474	0E	490	testp zf
0475	649E	491	b core
		492	;
0477	DA	493	cmpr a,21010b
0478	0E	494	testp zf
0479	64A4	495	b core
at specified		496	;
047B	DB	497	cmpr a,21011b
047C	0E	498	testp zf

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LOC	OBJ	LINE	SOURCE	STATEMENT
047D	64ED	499	b	coe000 ; conditional poll
		500		
047F	D8	501	cmpr	a,21000b
RDM PAGE NO. 18				
0480	65D9	502	b	core ; not implied comma
		503		
		504		
		505		insert character on device display
		506		
		507		
0482	3C37	508	ld	a,ldat11
0484	3F35	509	st	a,ldatm1
0486	3C38	510	ld	a,ldat12
0488	3F36	511	st	a,ldatm2
		512		
048A	3C81	513	ld	a,data0h
048C	38	514	xch	a,h
048D	3C88	515	ld	a,data0l
048F	31	516	xch	a,l
		517		
0490	2310	518	call	ledd
		519		
0492	38	520	xch	a,h
0493	3F38	521	st	a,ldat12
		522		
0495	31	523	xch	a,l
0496	3F37	524	st	a,ldat11
		525		
0498	2350	526	call	flash
		527		
049A	65D9	528	b	core
049C	65D9	529	b	core
		530		
		531		
		532		read device data
		533		
		534		
049E	2050	535	coe000: call	rkce
		536		
04A0	65D9	537	b	core
04A2	65D9	538	b	core
		539		
		540		
		541		display character at specified position
		542		
		543		
04A4	3C83	544	coe000: ld	a,data1h
04A6	38	545	xch	a,h
04A7	3C82	546	ld	a,data1l
04A9	31	547	xch	a,l
		548		
04AA	2310	549	call	ledd
		550		

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PAGE 6

LOC	OBJ	LINE	SOURCE STATEMENT
04AC	3C80	551	ld a,data01
04AE	3833	552	and a,20011b
		553	
04B0	5C	554	test a,0
04B1	64CC	555	b ccoa10 ; lsd change
		556	
04B3	30	557	xch a,h
04B4	3F36	558	st a,ldata2
		559	
04B6	31	560	xch a,l
04B7	3F35	561	st a,ldata1
		562	
04B9	3C81	563	ld a,data0h
04BB	3838	564	and a,21000b
04BD	0E	565	testp zf
04BE	64DF	566	b ccoa02
		567	
		568	msd flashing
		569	

ROM PAGE NO.19

04C0	3C33	570	ld a,displw
04C2	3821	571	or a,20011b
04C4	3F33	572	st a,displw
		573	
04C6	2350	574	coea01: call flash
		575	
04C8	65D9	576	b core
04CA	65D9	577	b core
		578	
		579	
04CC	30	580	coea10: xch a,h
04CD	3F38	581	st a,ldat12
		582	
04CF	31	583	xch a,l
04D0	3F37	584	st a,ldat11 ; lsd change
		585	
04D2	3C81	586	ld a,data0h
04D4	3838	587	and a,21000b
04D6	0E	588	testp zf
04D7	A6	589	b ccoa03
		590	
		591	lsd flashing
		592	
04D8	3C33	593	ld a,displw
04DA	3822	594	or a,20011b
04DC	3F33	595	st a,displw
		596	
04DE	86	597	b ccoa01
		598	
04DF	3C33	599	coea02: ld a,displw
04E1	383E	600	and a,21110b
04E3	3F33	601	st a,disolw ; msd steady
		602	

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LOC	OBJ	LINE	SOURCE STATEMENT
04E3	86	603	b coea01
		604	;
04E6	3C33	605	coea03: ld a, displw
04E8	383D	606	and a, \$1101b
04EA	3F33	607	st a, displw ; led steady
		608	;
04EC	86	609	b coea01
		610	;
		611	;
		612	conditional poll
		613	;
		614	;
04ED	395F	615	coeb00: clr servrc, 1
		616	;
04EF	2050	617	call rkce
		618	;
04F1	65D9	619	b core
04F3	65D9	620	b core
		621	;
		622	;
		623	command '00' - '07'
		624	;
		625	;
04F5	D1	626	coex0: cmpr a, \$2001b
04F6	0E	627	testp zf
04F7	651B	628	b coe100 ; indicator power c
ontrol			
		629	;
04F9	D2	630	cmpr a, \$2010b
04FA	0E	631	testp zf
04FB	6534	632	b coe200 ; indicator mode se
lect			
		633	;
04FD	D3	634	cmpr a, \$2011b
04FE	0E	635	testp zf
04FF	654E	636	b coe300 ; device input cont
rol			
		637	;
ROM PAGE NO. 20 *			
0501	D4	638	cmpr a, \$20100b
0502	0E	639	testp zf
0503	6563	640	b coe400 ; device output con
trol			
		641	;
0505	D5	642	cmpr a, \$20101b
0506	0E	643	testp zf
0507	6592	644	b coe500 ; power relay contr
ol			
		645	;
0509	D6	646	cmpr a, \$20110b
050A	0E	647	testp zf
050B	65A2	648	b coe600 ; clear device disp
lay			
		649	;
050D	D7	650	cmpr a, \$20111b
050E	0E	651	testp zf
050F	65C4	652	b coe700 ; device display co
ntrol			

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LOC	OBJ	LINE	SOURCE STATEMENT
		655	; read device status
		656	;
		657	;
0511	39A2	658	test spush,2
0513	65D9	659	b core
		660	;
		661	;
0515	3962	662	rds000: clr spush,2
		663	;
0517	395F	664	clr servrc,1
		665	;
0519	65A2	666	b core600
		667	;
		668	;
		669	;
		670	; indicator power control
		671	;
		672	;
051B	3C80	673	core100: ld a,data01
051D	0E	674	testp zf
051E	AB	675	b core110
		676	;
		677	; indicator 'on'
		678	;
051F	3C34	679	ld a,dispiw
0521	3822	680	or a,20010b
0523	3F34	681	st a,dispiw
		682	;
0525	3903	683	set spush,0 ; indicator current
ly on			
		684	;
0527	2350	685	core120: call flash
		686	;
0529	65D9	687	b core
		688	;
		689	; indicator 'off'
		690	;
052B	3C34	691	core110: ld a,dispiw
052D	383D	692	and a,21101b
052F	3F34	693	st a,dispiw
		694	;
0531	3943	695	clr spush,0 ; indicator current
ly off			
		696	;
0533	A7	697	b core120
		698	;
		699	;
		700	; indicator mode select
		701	;
		702	;
0534	3C80	703	core200: ld a,data01
0536	0E	704	testp zf
0537	6545	705	b core210
		706	;
0539	3C34	707	ld a,dispiw
053B	3821	708	or a,20001b
053D	3F34	709	st a,dispiw

LOC. OBJ	LINE	SOURCE STATEMENT	
	710 ;		
053F 3913	711	set spush,1	; indicator current
ly flashing			
	712 ;		
ROM PAGE NO.21 *			
0541 2350	713	coe220: call flash	
	714 ;		
0543 65D9	715	b core	
	716 ;		
0545 3C34	717	coe210: ld a,dispiw	
0547 383E	718	and a,\$1110b	
0549 3F34	719	st a,dispiw	
	720 ;		
054B 3953	721	clr spush,1	; indicator current1
y non-flashing			
	722 ;		
054D 81	723	b coe220	
	724 ;		
	725 ;		
	726 ;	device input control	
	727 ;		
	728 ;		
054E 3C81	729	coe300: ld a,data0h	
0550 5F	730	test a,3	
0551 94	731	b coe310	
	732 ;		
0552 65D9	733	b core	
	734 ;		
0554 3680	735	coe310: diclr il,h'00	
0556 40	736	ld a,2h'0	
0557 3A8C	737	out a,%opic	
	738 ;		
0559 3935	739	set spuvs1,3	
	740 ;		
055B 3846	741	clr %op06,0	
	742 ;		
055D 3836	743	set %op06,3	; port set
	744 ;		
055F 3640	745	diclr il,h'00	
	746 ;		
0561 65D9	747	b core	
	748 ;		
	749 ;		
	750 ;	device output control	
	751 ;		
	752 ;		
0563 3C81	753	coe400: ld a,data0h	
0565 5F	754	test a,3	
0566 6585	755	b coe411	; vlf output
t disable			
	756 ;		
0568 3953	757	clr spuvs1,1	; key board
enable			
	758 ;		
056A 3C80	759	coe410: ld a,data01	
056C 5C	760	test a,0	
056D B8	761	b coe420	

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LOC	OBJ	LINE	SOURCE STATEMENT
		762 ;	
056E	36AA	763	diclr il,101010b
0570	47	764	ld a,20111b
0571	3F1C	765	st a,sirb
0573	13	766	xch a,sir
0574	366A	767	diclr il,101010b ; remote co
ntrol enable			
		768 ;	
0576	65D9	769	b core
		770 ;	
0578	36AA	771	coe420: diclr il,101010b
057A	46	772	ld a,20110b
057B	3F1C	773	st a,sirb
057D	13	774	xch a,sir
057E	40	775	ld a,20000b
057F	3A8D	776	out a,%opld ; timer 2 s
top			
ROM PAGE NO.22 *			
0581	366A	777	diclr il,101010b ; remote co
ntrol disable			
		778 ;	
0583	65D9	779	b core
		780 ;	
0585	36AA	781	coe411: diclr il,101010b
0587	3915	782	set spuval,1 ; key board
disable			
0589	41	783	ld a,2h'1
058A	3F23	784	st a,spusk
058C	3F24	785	st a,spucp
		786 ;	
058E	2050	787	call rkce
		788 ;	
0590	6578	789	b coe420
		790 ;	
		791 ;	
		792 ;	power relay control
		793 ;	
		794 ;	
0592	3C80	795	coe500: ld a,data01
0594	0E	796	testp zf
0595	9C	797	b coe501
		798 ;	
0596	3B54	799	clr %op04,1 ; power relay on
		800 ;	
0598	3932	801	set spuval,3 ; power relay curre
ntly on			
		802 ;	
059A	65D9	803	b core
		804 ;	
059C	3B14	805	coe501: set %op04,1 ; power relay off
		806 ;	
059E	3972	807	clr spuval,3 ; power relay curre
ntly off			
		808 ;	
05A0	65D9	809	b core
		810 ;	
		811 ;	
		812 ;	clear device display
		813 ;	

LOC	OBJ	LINE	SOURCE STATEMENT
		814	;
05A2	4F	815	coe600: ld a,2h'f
05A3	3F35	816	st a,ldatm1
05A5	3F37	817	st a,ldat11
05A7	3F39	818	st a,ldasm1
05A9	3F3B	819	st a,ldasm11
		820	;
05AB	3C36	821	ld a,ldatm2
05AD	3827	822	or a,20111b
05AF	3F36	823	st a,ldatm2
		824	;
05B1	3C38	825	ld a,ldat12
05B3	3827	826	or a,20111b
05B5	3F38	827	st a,ldat12
		828	;
05B7	3C3A	829	ld a,ldasm2
05B9	3827	830	or a,20111b
05BB	3F3A	831	st a,ldasm2
		832	;
05BD	3C3C	833	ld a,ldasm12
05BF	3827	834	or a,20111b
ROM PAGE NO.23 *			
05C1	3F3C	835	st a,ldasm12
		836	;
05C3	99	837	b core
		838	;
		839	;
		840	; device display control
		841	;
		842	;
05C4	3C80	843	coe700: ld a,data01
05C6	0E	844	testp zf
05C7	92	845	b coe701
		846	;
05C8	3C33	847	ld a,displw
05CA	3823	848	or a,20011b
05CC	3F33	849	st a,displw
		850	;
05CE	2350	851	coe703: call flash
		852	;
05D0	99	853	b core
05D1	99	854	b core
		855	;
05D2	3C33	856	coe701: ld a,displw
05D4	383C	857	and a,21100b
05D6	3F33	858	st a,displw
		859	;
05D8	0E	860	b coe703
		861	;
		862	;
		863	; return
		864	;
		865	;



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LOC	OBJ	LINE	SOURCE STATEMENT
05D9	3974	866	core: clr spuvs,3 ; clear 'command ex
05DB	6453	867 ;	
		868	b mai4
		869 ;	
		870 ;	
		871 ;	
		872 ;	keyscan
		873 ;	
		874 ;	
05DD	3995	875	mai3: test spuvs,1
05DF	A4	876	b mai30
		877 ;	
05E0	3965	878	clr spuvs,2
		879 ;	
05E2	6457	880	b mai5
		881 ;	
05E4	2100	882	mai30: call keys
		883 ;	
05E6	3965	884	clr spuvs,2
		885 ;	
05E8	6457	886	b mai5
		887 ;	
		888	end

ASSEMBLY COMPLETE, 0 PROGRAM ERROR(S)

## SYMBOL TABLE

COE100	0518	COE110	0528	COE120	0527	COE200	0534
COE210	0545	COE220	0541	COE300	054E	COE310	0554
COE400	0563	* COE410	056A	COE411	0585	COE420	0578
COE500	0592	COE501	059C	COE600	05A2	COE700	05C4
COE701	05D2	COE703	05CE	COE900	049E	COEA00	04A4
COEA01	04C6	COEA02	04DF	COEA03	04E6	COEA10	04CC
COEB00	04ED	COEX0	04F5	* COMMA0	0013	COMMAH	0015
COMMAL	0014	CORE	05D9	DATA0H	0001	DATA0L	0000
DATA1H	0003	DATA1L	0002	* DATA2H	0005	* DATA2L	0004
* DATA3H	0007	* DATA3L	0006	* DATA4H	0009	* DATA4L	0008
* DATACT	0200	* DCH	00FE	* DCL	00FC	* DISPA	0032
* DISPH	0031	DISPIH	0034	* DISPL	0030	DISPLH	0033
EIRB	001C	FLASH	0350	* INCOTH	000C	* INCOTL	000A
* INCOTH	000B	* KEST	0022	KEST0H	0043	KEST0L	0042
* KEST1H	0045	* KEST1L	0044	* KEST2H	0047	* KEST2L	0046
* KEST3H	0049	* KEST3L	0048	* KEST4H	004B	* KEST4L	004A
* KEST5H	004D	* KEST5L	004C	* KESTBH	0021	* KESTBL	0020
* KEYND	0029	* KEYNN	002A	KEYOD	002B	* KEYON	002C
KEYB	0100	* KEYSB	0250	* KEYSO	000E	* KEYT	0300
* KEYTB	00C9	* LCICOT	000D	LDASL1	003B	LDASL2	003C
LDASM1	0039	LDASM2	003A	LDATL1	0037	LDATL2	0038
LDATM1	0035	LDATM2	0036	* LDISP	0000	LECOTH	000F
LECOTL	000D	LECOTH	000E	LEDD	0310	* LIOVF1	0500
* LIOVF2	0D00	* LREMO	0E00	* LVLFEH	0C00	MAI0	03E5
MAI00	044B	MAI1	044D	MAI2	0469	* MAI20	0450
MAI3	05DD	MAI30	05E4	MAI4	0453	MAI5	0457
MAI61	0460	MAI62	0463	* MAIN	03E0	* OVER2A	0072
* OVER2H	0071	* OVER2L	0070	* OVERA1	0012	* OVERH1	0011
* OVERL1	0010	* PARITT	000C	* PARITY	000B	* RD0000	0515
* READC	0028	* READN	0027	* REMD0	0060	* REMD1	0061
* REMD2	0062	* REMD3	0063	* REMD4	0064	* REMD5	0065
* REMD6	0066	* REMD7	0067	* REMDA	006A	* REMDH	0069
* REMOL	0060	RKCE	0050	* RNH	006B	* RNL	006D
* RNH	006C	RWRPCH	00CA	* RWRPCL	00C8	* RWRPCN	00C9
SERVRC	000F	SPUCP	0024	SPUSH	0003	SPUSK	0023
SPUSL	0002	* SPUTT	0018	SPUVDH	0004	* SPUVSH	0000
SPUVSL	0005	SPUVUM	0001	SPW	00FF	* SPWB	00C7
* TABLE	0000	* TIMR2H	00FA	* TIMR2L	00FA	* TIMR2N	00F9
TIMRHN	00F6	* TIMRHD	001B	TIMRLN	00FA	* TIMRLD	0019
TIMRMN	00F3	* TIMRMD	001A	* VLFC	000A	* VLFEH	0016
* VLFRB	0009	* VLFTB	0008	* VLFTH	0007	* VLFTL	0006
* VLFXA	0052	* VLFXH	0051	* VLFXL	0050	* WARPCL	00CA
* WARPCH	00C5	* WRITH	0026	* WRITEN	0025		

DEFINED 171 USER SYMBOL(S)

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PAGE 1

LOC OBJ LINE SOURCE STATEMENT

```

1 |-----|
2 |                                     7.1983.
3 |      liovf1.asm      V1.0
4 |                                     (TMP4740P)
5 |
6 |      vlf communication routine
7 |
8 |
9 |-----|

```

enolist

slist

296 ;

ROM PAGE NO. 0

0010	297	org	h'010	; routine table
0010	298			
	299			
0010 66B2	300	b	rd	; start bit detect
	301			
0012 66FC	302	b	rmi	; ai bit detect
	303			
0014 6719	304	b	rca	; address detect
	305			
0016 673E	306	b	rcf	; command detect
	307			
0018 67D4	308	b	rcp	; parity in
	309			
001A 67EE	310	b	tra	; 'ack' or 'nack'
	311			
001C 67FA	312	b	rcstn	; stop bit in
	313			
001E 6834	314	b	rstd	; dany to rcstab
	315			
0020 6838	316	b	rcstab	; stop bit in
	317			
0022 6841	318	b	rds	; data in
	319			
0024 6871	320	b	rdp	; parity in
	321			
0026 687F	322	b	tdack	; 'ack' or 'nack'
	323			
0028 6885	324	b	rdast	
	325			
	326	!!!!		
	327			
002A 68C2	328	b	td	; transmit
	329			

LOC	OBJ	LINE	SOURCE STATEMENT
002C	68EB	330	b tdl ; data out
002E	68F1	331 ;	
		332	b trwl ; detect 'wi'
		333 ;	
0030	6909	334	b rdany ; dany to rca
		335 ;	
0032	6912	336	b tdo ; data out
		337 ;	
0034	6930	338	b tp ; parity out
		339 ;	
0036	693E	340	b tici ; 'ici' bit out
		341 ;	
0038	6944	342	b rtask ; receive 'ack'
		343 ;	
003A	6983	344	b tst ; out 'stop'
		345 ;	
003C	6989	346	b rst ; receive 'stop'
		347 ;	
		348 ;	
		349 ;	

ROM PAGE NO. 24

0600	350	org	h'600
	351 ;		
	352 ;		
	353 ;	register push	
	354 ;		
0600 3986	355	set	xop06,0
0602 3F12	356	lovfi:	st a,overal
0604 2910	357	xch	hl,overll
	358 ;		
	359 ;	timerl.start	
	360 ;		
0606 3C1B	361	ld	a,timrho
0608 3FF6	362	st	a,timrhn
060A 3C1A	363	ld	a,timrho
060C 3FF3	364	st	a,timrhn
060E 3C19	365	ld	a,timrlo
0610 3FF4	366	st	a,timrln
	367 ;		
	368 ;	check mode	
	369 ;	( normal or not )	
	370 ;		
0612 3980	371	test	spuvsh,0
0614 B5	372	b	vl9001 ;routine for abnorm
al	373 ;		mod
	374 ;		
	375 ;	check mode	
	376 ;	( transmit or not )	
	377 ;		
0615 39D0	378	testp	spuvsh,1
0617 A3	379	b	vl9010 ;routine for transn
it	380 ;		mod
	381 ;		
0618 3BC0	381	testp	xip00,0

!

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PAGE 4

LOC	OBJ	LINE	SOURCE STATEMENT
		434 ;	
0647 3954		435 vlf002: clr	spuvda,1 ; clear '1200 bit c
ounting'			
0649 3941		436	clr spuvus,0 ; clear 'previous
		437 ;	command needs d
ata'			
064B 3951		438	clr spuvus,1 ; clear 'previous
		439 ;	command require
s data'			
064D 3921		440	set spuvus,2 ; 'command inhibit'
on			
064F 3900		441	set spuvsh,0 ; set normal mode
0651 3950		442	clr spuvsh,1 ; set receive mode
		443 ;	
0653 80		444	b vlf005 ; branch on
		445 ;	'set cry enable
		446 ;	
		447 ;	----- 10sec counted -----
		448 ;	
0654 3931		449 vlf003: set	spuvus,3 ; set framing error
0656 3964		450	clr spuvda,2 ; clear '10sec coun
ting'			
		451 ;	
0658 3C23		452	ld a,spusk
065A 3F24		453	st a,spucp
		454 ;	
065C 2050		455	call ruce
		456 ;	
065E 4F		457	ld a,2h'f
065F 3FF6		458	st a,tierhn
0661 47		459	ld a,2h'7
0662 3FF3		460	st a,tieram
0664 4C		461	ld a,2h'c
0665 3FF4		462	st a,tierln
		463 ;	
0667 44		464	ld a,2h'4
0668 3A8C		465	out a,xopic ; 11bit timer setti
ng			
		466 ;	
066A 3975		467	clr spuval,3 ; 1'st intr. enable
		468 ;	
066C 66AD		469	b vlf300 ; to return routine
		470 ;	
		471 ;	----- framing error bit on -----
066E 3C18		472 vlf004: ld	a,sputt
0670 D0		473	cmpr a,2h'0
0671 66A3		474	b v10040
		475 ;	
0673 3C53		476	ld a,frame
0675 DF		477	cmpr a,2h'f
0676 6609		478	b v10060
		479 ;	
0678 3B00		480	test xip00,0
067A 6670		481	b v10050
		482 ;	
067C 40		483	ld a,2h'0
067D 3F53		484	st a,frame
		485 ;	
067F 4F		486	ld a,2h'f

ROM PAGE NO.26

LOC	OBJ	LINE	SOURCE STATEMENT	
0680	3FF6	487	st a,timrhn	
0682	47	488	ld a,2h'7	
0683	3FF3	489	st a,timran	
0685	4C	490	ld a,2h'c	
0686	3FF4	491	st a,timrln	
		492		
0688	AD	493	b vlf300	
		494		
0689	3B80	495	v10050: test xip00,0	
068B	98	496	b v10050	
		497		
068C	3971	498	clr spuvum,3	; clear 'framing er
ror'				
068E	3921	499	set spuvum,2	; set 'command inh
bit'				
0690	3951	500	clr spuvum,1	; clear 'previous c
ommand		501		; requires an answ
		502	clr spuvum,0	; clear 'previous c
ommand		503		; needs data'
0692	3950	504	clr spuvsh,1	; set receive mode
0694	3900	505	set spuvsh,0	; set normal mode
		506		
0696	6640	507	b v1f005	; to 'set cry enabl
a'		508		
0698	4F	509	v10050: ld a,2h'f	
0699	3FF6	510	st a,timrhn	
069B	3FF3	511	st a,timran	
		512		
069D	3F53	513	st a,frame	
		514		
069F	4A	515	ld a,2h'a	
06A0	3FF4	516	st a,timrln	
		517		
06A2	AD	518	b vlf300	
		519		
06A3	40	520	v10040: ld a,2h'0	
06A4	3F18	521	st a,sputt	
		522		
06A6	3BC0	523	testp xip00,0	
06A8	AD	524	b vlf300	
		525		
06A9	4F	526	ld a,2h'f	
06AA	3F53	527	st a,frame	
		528		
06AC	98	529	b v10050	
		530		
		531		
		532	return routine ( vlf300 )	
		533		
06AD	3C12	534	vlf300: ld a,overal	; pop register
06AF	2910	535	xch hl,overll	
		536		
06B1	2B	537	reti	
		538		
		539		
		540	RD routine	

LOC	OBJ	LINE	SOURCE STATEMENT
		541	( in start bit )
		542	start bit
06B2 3BC0		543	testp xip00,0
06B4 66C2		544	b r00000
		545	it was not 'start
06B6 3935		546	set spuvs1,3
		547	external intr.
		548	inhibit
06B8 3961		549	clr spuvs0,2
hibit'		550	clear 'command in
06BA 3944		551	clr spuvs0,0
		552	clear 'cry enable
06BC 3B36		553	set xop06,3
		554	port set
		555	next intr.
06BE C1		556	ld h,2h'1
06BF E2		557	ld l,2h'2
		558	to Rmi routine

## ROM PAGE NO.27

06C0 41	561	ld a,2h'1	next intr. 1 bit
time	562		
	563	re-warp	
	564		
06C1 2A	565	r00001: ret	
	566		
	567	start bit not found	
	568		
06C2 3984	569	r00000: test spuvs0,0	
06C4 89	570	b r01000	cry enable ?
	571		
06C5 40	572	ld a,2h'0	
06C6 3A8C	573	out a,xopic	timer1 stop
	574		
06C8 81	575	b r00001	to re-warp
	576		
06C9 3940	577	r01000: clr spuvs0,0	to abnormal mode
	578		
06CB 3994	579	test spuvs0,1	
	580		
06CD AA	581	b r01110	must detect 'cry
enable'	582		
	583		
	584	1200 bit counting	
	585		
06CE 3C8C	586	r01100: ld a,inc0th	
06D0 3FF6	587	st a,timrhn	
06D2 3C8B	588	ld a,inc0th	
06D4 3FF5	589	st a,timrhn	
06D6 3C8A	590	ld a,inc0l	
06D8 3FF4	591	st a,timrhn	
	592		



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LOC	OBJ	LINE	SOURCE STATEMENT
06DA	48	593	ld a,2h'8
06DB	3A8C	594	out a,xoplc
06DD	3B36	595 ;	
		596	set xop06,3
		597 ;	
		598 ;	return
		599 ;	
06DF	3CC7	600 r01111:	ld a,spub
06E1	3FFF	601	st a,spw
		602 ;	
06E3	3C12	603	ld a,overal
06E5	2910	604	xch hl,overll
		605 ;	
06E7	3B46	606	clr xop06,0
		607 ;	
06E9	2B	608	reti
		609 ;	
06EA	3C8C	610 r01110:	ld a,incoth
06EC	3FF6	611	st a,timrnn
06EE	3C8B	612	ld a,incots
06F0	3FF5	613	st a,timrnn
06F2	3C8A	614	ld a,incotl
06F4	3FF4	615	st a,timrln
		616 ;	
06F6	44	617	ld a,2h'4
06F7	3A8C	618	out a,xoplc
		619 ;	
06F9	3B36	620	set xop06,3
		621 ;	
06FB	9F	622	b r01111
		623 ;	
		624 ;	
		625 ;	
		626 ;	
		627 ;	
		628 ;	Rmi routine
		629 ;	( in mi bit )
		630 ;	
		631 ;	
		632 ;	
06FC	39F9	633 rmi:	testp vlfrrb,3
06FE	670F	634	b rmi000
		635 ;	
		636 ;	'command' from ECU
		637 ;	
RDM PAGE NO.28			
0700	C1	638	ld h,2h'1
0701	E4	639	ld l,2h'4
		640 ;	to Rca routine
0702	40	641	ld a,2h'0
0703	3F16	642	st a,vlfec
clear			vlf error counter
		643 ;	
0705	3941	644	clr spuvum,0
			'previous command

LOC	OBJ	LINE	SOURCE STATEMENT	
		645		
0707	3951	646	clr spuvus,1	; needs data'
		647		; 'previous command
war				requires an ans
		648	parity & VLF counter	
		649	clear	
		650		
0709	2D09	651	rm1001: st zh'0,parity	
0709	2D0A	652	st zh'0,vlfc	; parity counter
		653		& VLF counter cl
ear				
		654		
		655	next intr.	
		656		
070D	41	657	ld a,zh'1	; next intr. 1bit t
ime				
		658		
		659	re-warp	
		660		
070E	2A	661	rm1002: ret	; re-warp
		662		
		663	'data' from ECU	
		664		
070F	3981	665	rm1000: test spuvus,0	
0711	95	666	b rm1003	; not need data
		667		
0712	C2	668	ld h,zh'2	
0713	E2	669	ld l,zh'2	; to Rdd routine
		670		
0714	89	671	b rm1001	; to parity clear
		672		
		673	not need 'data'	
		674		
0715	C1	675	rm1003: ld h,zh'1	
0716	EE	676	ld l,zh'e	; to Rstd routine
		677		
0717	43	678	ld a,zh'3	; next intr. 9bit t
ime				
		679		
0718	8E	680	b rm1002	; to re-warp
		681		
		682		
		683		
		684		
		685		
		686	Rca routine	
		687	( in command receive )	
		688		
		689		
0719	2F1A	690	rca: add vlfc,zh'1	; vlf counter
		691		increment
071B	2E3A	692	cmor vlfc,zh'3	
071D	84	693	b rca000	; vlfc () 3
		694		
		695	address check	
		696		
071E	3C09	697	ld a,vlfrb	
0720	07	698	rorc a	
0721	3837	699	and a,zh'7	

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LOC	OBJ	LINE	SOURCE STATEMENT	
0723	3F13	700	st a,comad	; address in
		701		
0725	3A20	702	in %ip00,a	
0727	07	703	rorc a	
0728	07	704	rorc a	
0729	3833	705	and a,2h'3	
072B	3802	706	add a,2h'2	; spu address
		707		
072D	3E13	708	cmpr a,comad	
072F	BA	709	b rca001	; address check NG
		710		
		711	next intr. address	
		712	matched	
		713		
0730	C1	714	ld h,2h'1	
0731	E6	715	ld l,2h'6	; to Rgf routine
		716		
0732	A1	717	rca002: ld a,2h'1	; next intr. 1bit t
ime		718		
		719	re-warp	
		720		
0733	2A	721	rca003: ret	; re-warp
		722		
		723	shift	
		724		
0734	3C09	725	rca000: ld a,vlfrb	
0736	07	726	rorc a	; shift
0737	3F09	727	st a,vlfrb	
		728		
0739	B2	729	b rca002	; next intr. 1bit t
ime		730		
		731	next intr. address	
		732	miss matched	
		733		
073A	C1	734	rca001: ld h,2h'1	
073B	EE	735	ld l,2h'e	; to Rstd
		736		
073C	42	737	ld a,2h'2	; next intr. 6 bit time
		738		
		739		
073D	B3	740	b rca003	; re-warp
		741		
		742		
		743		
		744		
		745		
		746	Rcf routine	
		747	( in command receive )	
		748		
		749		
		750	data set	
		751		
073E	2F1A	752	rcf: add vlfc,2h'1	; VLF counter increment
		753		

LOC	OBJ	LINE	SOURCE STATEMENT
ROM PAGE NO.29			
0740	2E7A	734	cmpr vifc,2h'7
0742	0E	735	testp zf
0743	8F	736	b rcf000
		737	; branch on command h1
0744	2E8A	738	cmpr vifc,2h'8
0746	0E	739	testp zf
0747	94	740	b rcf001
		741	; branch on read function
		742	
0748	3C09	743	ld a,vlfrb
074A	07	744	rorc a
074B	3F09	745	st a,vlfrb
		746	; data set
		747	
		748	next intr.
		749	
074D	41	750	rcf002: ld a,2h'1
ime		751	; next intr. 1bit t
		752	
		753	
		754	re-warp
		755	
074E	2A	756	rcf006: ret
		757	; re-warp
		758	
		759	read command lo
		760	
074F	3C09	761	rcf000: ld a,vlfrb
0751	3F14	762	st a,comma1
		763	
0753	8D	764	b rcf002
		765	; to next intr.
		766	
		767	read command h1
		768	
0754	3C09	769	rcf001: ld a,vlfrb
0756	07	770	rorc a
0757	07	771	rorc a
0758	07	772	rorc a
0759	3831	773	and a,20001b
075B	3822	774	or a,20010b
075D	3F15	775	st a,commah
		776	
		777	read , write ?
		778	
075F	3FFD	779	st a,dcm
0761	3C14	780	ld a,comma1
0763	3FFC	781	st a,dcl
0765	4F	782	ld a,2h'f
0766	3FFE	783	st a,dch
		784	
0768	33	800	ldl a,0dc
0769	3F25	801	st a,writen
076B	32	802	ldh a,0dc+
076C	3F27	803	st a,readn
		804	
076E	D0	805	cmpr a,2h'0
076F	0E	806	testp zf

LOC	OBJ	LINE	SOURCE STATEMENT	
0770	BC	807	b rcf100	; need not reading
		808		
		809	; read command	
		810		
0771	3901	811	set spuvm,0	; set previous comm
and need data				
		812		
0773	40	813	ld a,2h'0	
0774	3F28	814	st a,readc	; reading counter s
et				
		815		
		816	out 'mark' &	
		817	next address	
		818		
0775	3B76	819	rcf005: clr %op06,3	; out 'mark'
		820		
0778	C1	821	ld h,2h'1	
0779	E8	822	ld l,2h'8	; to Rcp routine
		823		
077A	40	824	ld a,2h'0	; next intr.1/2
		825		bit time
		826		
077B	8E	827	b rcf006	; to re-warp routin
		828		
		829	write command ?	
		830		
077C	3C25	831	rcf100: ld a,writen	
077E	D0	832	cmpr a,2h'0	
077F	0E	833	testp zf	
ROM PAGE NO.30				
0780	6776	834	b rcf005	; to Rcp routine
		835		
		836	write command	
		837		
0782	DF	838	cmpr a,2h'f	
0783	0E	839	testp zf	
0784	85	840	b rcf110	; conditional poll
		841		
0785	3914	842	set spuvm,1	; set previous comm
and require				
		843		answer
0787	2D1D	844	st 2h'1,lcicot	
		845		
0789	D1	846	cmpr a,20001b	
078A	98	847	b rcf120	; 'read device data
		848		command
		849		
		850	read sdu status command	
		851		
078B	41	852	ld a,2h'1	
078C	3F24	853	st a,spucp	
		854		
078E	3C02	855	ld a,spuul	
0790	3F06	856	st a,vlft1	
0792	3C03	857	ld a,souh	
0794	3F07	858	st a,vlft4	

LOC	OBJ	LINE	SOURCE STATEMENT
		859 ;	
0796	6776	860	b rcf005
		861 ;	
		862 ;	
		863 ;	read device data command
		864 ;	
		865 ;	
0798	3C42	866	rcf120: ld a,keat01
079A	3F06	867	st a,vlft1
079C	3C43	868	ld a,keat0h
079E	3F07	869	st a,vlftth
		870 ;	
07A0	3C23	871	ld a,spusk
07A2	0E	872	testp zf
07A3	AE	873	b rcf121
		874 ;	
07A4	3F24	875	st a,spucp
07A6	40	876	ld a,zh'0
07A7	3F17	877	st a,spuff
		878 ;	
07A9	44	879	rcf122: ld a,zh'4
07AA	3F26	880	st a,writen
		881 ;	
07AC	6776	882	b rcf005
		883 ;	
07AE	08	884	rcf121: inc a
07AF	3F24	885	st a,spucp
07B1	4F	886	ld a,zh'f
07B2	3F17	887	st a,spuff
		888 ;	
07B4	A9	889	b rcf122
		890 ;	
		891 ;	conditional poll
		892 ;	
07B5	3C42	893	rcf110: ld a,keat01
07B7	3F06	894	st a,vlft1
07B9	3C43	895	ld a,keat0h
07BB	3F07	896	st a,vlftth
		897 ;	
07BD	41	898	ld a,zh'1
07BE	3F0D	899	st a,lcicot

; no key stroke

; data in

## ROM PAGE NO.31

07C0	3F24	900	st a,spucp
		901 ;	
07C2	3B76	902	clr xop06,3
		903 ;	
07C4	3914	904	set souvdm,1
		905 ;	
07C6	3C23	906	ld a,spusk
07C8	0E	907	testp zf
07C9	8F	908	b rcf111
		909 ;	
07CA	40	910	ld a,zh'0

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PAGE 13

LOC	OBJ	LINE	SOURCE STATEMENT
07CB 3F17		911	st a,spuff
07CD 6776		912	b rcf005
		913	
07CF 4F		914	rcf111: ld a,2h'f
07D0 3F17		915	st a,spuff ; no keystroke
07D2 6776		916	b rcf005
		917	
		918	
		919	
		920	Rcp routine ( command read )
		921	
		922	
		923	
07D4 39CB		924	rcp: testp parity,0
07D6 A9		925	b rcp000 ; parity error
		926	
07D7 3C25		927	ld a,wrten
07D9 DF		928	cmpr a,2h'f
07DA A1		929	b rcp100 ; not conditional p
oll			
		930	
07DB 2E0F		931	cmpr servrc,2h'0
07DD A1		932	b rcp100 ; data in
		933	
07DE 3954		934	clr spuvm,1 ; clear previous co
msand			
		935	need answer bit
07E0 A9		936	b rcp000
		937	
07E1 3948		938	rcp100: clr vltb,0 ; send 'ack'
		939	
		940	mode change
		941	
07E3 3910		942	rcp003: set spuvm,1 ; change mode
		943	to 'transmit'
		944	next intr.
		945	
07E5 C1		946	rcp004: ld h,2h'1
07E6 EA		947	ld l,2h'a ; to Tra routine
		948	
07E7 40		949	ld a,2h'0 ; next intr. 1/2 b1
t			
		950	time
		951	re-warp
		952	
07E8 2A		953	ret
		954	
		955	parity error
		956	
07E9 3921		957	rcp000: set spuvm,2 ; set 'command inhi
bit'			
		958	
07EB 3908		959	set vltb,0 ; send 'nack'
07ED		960	
07ED A3		961	b rcp003
		962	
		963	
		964	
		965	

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LOC	OBJ	LINE	SOURCE STATEMENT
		966	
		967	
		968	Tra
		969	
		970	
		971	
		972	mode change
		973	
07EE	3930	974	tra: clr spuvs,1   mode change
		975	to receive mode
07F0	39E1	976	testp spuvs,2
07F2	87	977	b tra000   branch on
		978	'command inhibit
		979	next intr.
		980	
07F3	C1	981	ld h,2h'1
07F4	EC	982	ld l,2h'c   to Rctn routine
		983	
07F5	45	984	tra001: ld a,2h'5   next intr.
		985	bit time
		986	
		987	re-warp
		988	
07F6	2A	989	ret
		990	
		991	next intr.
		992	in parity error
		993	
07F7	C2	994	tra000: ld h,2h'2
07F8	60	995	ld l,2h'0   to Rctab routine
		996	
07F9	85	997	b tra001
		998	
		999	
		1000	
		1001	
		1002	Rctn routine
		1003	
		1004	
		1005	
		1006	
07FA	39B9	1007	rcstn: test vlfrc,3
07FC	6820	1008	b rcstn0   framing error
		1009	
		1010	read ?
		1011	
07FE	3C27	1012	ld a,readn
ROM PAGE NO. 32			
0800	D0	1013	cmpr a,0000b
0801	0E	1014	testp zf
0802	97	1015	b rcstn1   branch on
		1016	read comman
		1017	read or write command



LOC	OBJ	LINE	SOURCE STATEMENT
		1018 ;	
0003	3940	1019	rcstn6: clr spuvsb,0 ; to abnormal mode
		1020 ;	
		1021 ;	1200 bit timer on
		1022 ;	
0005	3914	1023	rcstn2: set spuvsd,1 ; '1200 bit timer'
	on		
		1024 ;	
0007	42	1025	ld a,2h'2
0008	3FF6	1026	st a,timrhn
0009	4C	1027	ld a,2h'c
000B	3FF3	1028	st a,timrhn
000D	4F	1029	ld a,2h'f
000E	3FF4	1030	st a,timrln
		1031 ;	
0010	48	1032	ld a,2h'8
0011	3A8C	1033	out a,xopic
		1034 ;	
		1035 ;	external intr.enable
		1036 ;	
0013	3975	1037	rcstn3: clr spuvs1,3
		1038 ;	
		1039 ;	return
		1040 ;	
0015	66DF	1041	b r01111
		1042 ;	
0017	3C25	1043	rcstn1: ld a,write
0019	D0	1044	cmpr a,20000b
001A	B1	1045	b rcstn7 ; branch on
		1046 ;	write command
		1047 ;	
		1048 ;	command ended
		1049 ;	
001B	3940	1050	clr spuvsb,0 ; to abnormal mode
		1051 ;	
001D	3934	1052	set spuvsd,3 ; 'command execute'
		1053 ;	
001F	93	1054	b rcstn3 ; to return
		1055 ;	
		1056 ;	framing error
		1057 ;	
0020	3940	1058	rcstn0: clr spuvsb,0 ; to abnormal mode
		1059 ;	
0022	3931	1060	set spuvsd,3 ; framing error
		1061 ;	
0024	4F	1062	ld a,2h'f
0025	3F53	1063	st a,frame
0027	3FF6	1064	st a,timrhn
0029	3FF3	1065	st a,timrhn
		1066 ;	
002B	4A	1067	ld a,2h'a
002C	3FF4	1068	st a,timrln
		1069 ;	
002E	3B36	1070	set xop06,3
		1071 ;	
0030	93	1072	b rcstn3 ; to return

LOC	OBJ	LINE	SOURCE STATEMENT
		1073 ;	
0031	3910	1074	rcstn7: set spuvsb,1 ; to transmit mode
0033	83	1075	b rcstn6
		1076 ;	
		1077 ;	
		1078 ;	
		1079 ;	
		1080 ;	
		1081 ;	Rstd ( dummy routine )
		1082 ;	
		1083 ;	
		1084 ;	
		1085 ;	next intr.
		1086 ;	
0034	C2	1087	rstds: ld h,2h'2
0035	E0	1088	ld l,2h'0 ; to Rctab
		1089 ;	
0036	45	1090	ld a,2h'5 ; next intr.
		1091 ;	11 bit time
		1092 ;	
		1093 ;	re-warp
0037	2A	1094	ret
		1095 ;	
		1096 ;	
		1097 ;	
		1098 ;	
		1099 ;	
		1100 ;	Rctab
		1101 ;	
		1102 ;	
		1103 ;	
		1104 ;	check stop bit
		1105 ;	
0038	39B9	1106	rcstab: test v1frb,3
0039	00	1107	b rcstn0 ; framing error
		1108 ;	
003B	3940	1109	rcstab: clr spuvsb,0 ; to abnormal mode
		1110 ;	
003D	3975	1111	clr spuvs1,3 ; external intr. en
able		1112 ;	
003F	66DF	1113	b r01111 ; return
		1114 ;	
		1115 ;	
		1116 ;	
		1117 ;	Rdd ( data receive )
		1118 ;	
		1119 ;	
		1120 ;	
ROM PAGE NO. 33 *			
0041	2E3A	1121	rdd: cmpr v1fc,2h'3
0043	0E	1122	testp zf
0044	98	1123	b rdd000 ; data 1 set
		1124 ;	

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LDC OBJ	LINE	SOURCE STATEMENT
0845 2E7A	1125	cmpr v1fc,2h'7
0847 A8	1126	b rdd001
	1127	;
	1128	; data h set
	1129	;
0848 3C28	1130	ld a,readc
084A 05	1131	rolc a
084B 3821	1132	or a,20001b
084D 31	1133	xch a,l
084E C8	1134	ld h,2h'8
084F 3C09	1135	ld a,vlfrb
0851 0F	1136	st a,0h1 ; data in
	1137	;
0852 3B76	1138	clr xop06,3 ; out 'mark'...
	1139	;
	1140	; to Rdp routine
	1141	;
0854 C2	1142	ld h,2h'2
0855 E4	1143	ld l,2h'4 ; to Rdp
	1144	;
0856 40	1145	ld a,2h'0 ; next intr.
	1146	1/2 bit time
	1147	;
	1148	; re-warp
	1149	;
0857 2A	1150	rdd002: ret
	1151	;
	1152	; data in
	1153	;
0858 2F1A	1154	rdd000: add v1fc,2h'1
	1155	;
085A 3C28	1156	ld a,readc
085C 05	1157	rolc a
085D 383E	1158	and a,21110b
085F 31	1159	xch a,l
0860 C8	1160	ld h,2h'8
0861 3C09	1161	ld a,vlfrb
0863 0F	1162	st a,0h1 ; data in
	1163	;
0864 41	1164	ld a,2h'1
0865 C2	1165	ld h,2h'2
0866 E2	1166	ld l,2h'2
	1167	;
0867 97	1168	b rdd002 ; to return
	1169	;
	1170	; shift
	1171	;
0868 2F1A	1172	rdd001: add v1fc,2h'1 ; v1f counter
	1173	;
086A 3C09	1174	ld a,vlfrb
086C 07	1175	rorc a
086D 3F09	1176	st a,vlfrb ; shift
	1177	;
086F 41	1178	ld a,2h'1
	1179	;

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LOC	OBJ	LINE	SOURCE STATEMENT
0870	97	1180	b rdd002 ; to return
		1181	;
		1182	;
		1183	;
		1184	;
		1185	;
		1186	Rdp ( parity bit )
		1187	;
		1188	;
		1189	;
0871	39CB	1190	rdp: testp parity,0
0873	BC	1191	b rdp000 ; parity error
		1192	;
0874	3948	1193	clr vltb,0 ; set 'ack'
		1194	;
0876	3910	1195	rdp001: set spuvsb,1 ; set to transmit m
ods		1196	;
		1197	; to Tdack routine
		1198	;
0878	C2	1199	ld h,2h'2
0879	E6	1200	ld l,2h'6 ; to Tdack
		1201	;
087A	40	1202	ld a,2h'0 ; next intr. 1/2 bit
		1203	;
		1204	; re-warp
		1205	;
087B	2A	1206	ret
		1207	;
		1208	; set 'nack'
		1209	;
087C	3908	1210	rdp000: set vltb,0 ; set 'nack'
		1211	;
087E	B6	1212	b rdp001 ; to return
		1213	;
		1214	;
		1215	;
		1216	;
		1217	;
		1218	Tdack out ( 'ack' or 'nack' )
		1219	;
		1220	;
		1221	;
087F	3950	1222	tdack: clr spuvsb,1 ; to receive mode
		1223	;
		1224	; to Rdast routine
		1225	;
ROM PAGE NO. 34 *			
0881	C2	1226	ld h,2h'2
0882	E8	1227	ld l,2h'8 ; to Rdast
		1228	;
0883	45	1229	ld a,2h'5 ; next intr.
		1230	;
		1231	; re-warp 11 bit time

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LOC	OBJ	LINE	SOURCE STATEMENT
		1232	;
0884	2A	1233	ret
		1234	;
		1235	;
		1236	;
		1237	Rdast ( stop bit )
		1238	;
		1239	;
		1240	;
0885	39B9	1241	rdast: test vlfcb,3
0887	6820	1242	b rctn0 ; stop bit error
		1243	;
0889	39C8	1244	testp vlfcb,0
088B	AE	1245	b rdast4
		1246	;
088C	3C28	1247	rdast6: ld a, readc
088E	08	1248	inc a
088F	3F28	1249	st a, readc
0891	3E27	1250	cmpr a, readn
0893	0E	1251	testp zf
0894	A4	1252	b rdast3 ; the end
		1253	;
		1254	; again
		1255	1200 bit timer start
		1256	;
0895	42	1257	ld a, 2h'2
0896	3FF6	1258	st a, timerh
0898	4C	1259	ld a, 2h'c
0899	3FF3	1260	st a, timern
089B	4F	1261	ld a, 2h'f
089C	3FF4	1262	st a, timerl
		1263	;
089E	48	1264	ld a, 2h'8
089F	3A8C	1265	out a, Xoplc ; timer start
		1266	;
08A1	3914	1267	set spuvm, 1 ; 1200bit timer bit
		1268	;
08A3	AB	1269	b rdast1 on
		1270	;
		1271	; set 'command execute bit'
		1272	;
08A4	3934	1273	rdast3: set spuvm, 3 ;
		1274	;
08A6	3941	1275	clr spuvm, 0 ; clear previous co
command need			data bit
		1276	;
		1277	; to return
		1278	;
08A8	3940	1279	rdast1: clr spuvm, 0 ; to abnormal mode
		1280	;
08AA	3975	1281	clr spuvm, 3 ; 1'st intr. enable
		1282	;
08AC	66DF	1283	b r01111 ; return
		1284	;
08AE	3C16	1285	rdast4: ld a, vlfec
08B0	08	1286	inc a

LOC	OBJ	LINE	SOURCE STATEMENT
08B1	3F16	1287	st a,vlfec
		1288	;
08B3	D5	1289	cmpr a,zn'5
08B4	88	1290	b rdast5
		1291	;
08B5	3924	1292	set spuvm,2
08B7	3B36	1293	set %op06,3
08B9	69B6	1294	b rst004
		1295	;
08BB	3C28	1296	rdast5: ld a,readc
08BD	09	1297	dec a
08BE	3F28	1298	st a,readc
		1299	;
ROM PAGE NO. 35			
08C0	688C	1300	b rdast6
		1301	;
		1302	;
		1303	;
		1304	TO routine
		1305	;
		1306	;
		1307	;
		1308	start bit ?
		1309	;
08C2	38C8	1310	t0: testp %ip00,0
08C4	94	1311	b t00000
		1312	;
08C5	3935	1313	set spuvm,3
		1314	;
08C7	40	1315	ld a,zn'0
08C8	3F0C	1316	st a,paritt
		1317	;
08CA	3C06	1318	ld a,vlft1
08CC	3F08	1319	st a,vlftb
		1320	;
08CE	3B76	1321	clr %op06,3
		1322	;
		1323	;
		1324	next intr.
		1325	;
08D0	C2	1326	ld h,zn'2
08D1	EC	1327	ld l,zn'c
		1328	;
08D2	40	1329	ld a,zn'0
		1330	;
		1331	re-warp
		1332	;
08D3	2A	1333	ret
		1334	;
		1335	;
		1336	start bit error
		1337	;
08D4	3914	1338	t00000: set spuvm,1
			;

; 10 sec bit on

; not start bit

; external intr.  
disable; transmit parity  
reset

; transmit data in

; out 'mark'

; to Td1 routine

; 1/2 bit time

; '1200 bit countin

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LOC	OBJ	LINE	SOURCE STATEMENT
		1339	;
08D6	3940	1340	clr spuvsh,0 ; abnormal mode
		1341	;
		1342	out 'space'
		1343	;
08D8	3B36	1344	set %op06,3 ; out 'space'
		1345	;
		1346	1200 bit timer continues
		1347	;
08DA	3C8C	1348	ld a,incotb
08DC	3FF6	1349	st a,timrhn
08DE	3C8B	1350	ld a,incotw
08E0	3FF5	1351	st a,timrwn
08E2	3C8A	1352	ld a,incotl
08E4	3FF4	1353	st a,timrln
		1354	;
08E6	48	1355	ld a,2h'8
08E7	3A8C	1356	out a,%opic ; 1200 bit timer co
ntinues		1357	;
		1358	;
		1359	return
		1360	;
08E9	66DF	1361	b r01111
		1362	;
		1363	;
		1364	;
		1365	Tdl routine
		1366	;
		1367	;
		1368	;
		1369	mode change
		1370	;
08EB	3950	1371	tdi: clr spuvsh,1 ; receive mode
		1372	;
		1373	next intr.
		1374	;
08ED	C2	1375	ld h,2h'2
08EE	EE	1376	ld l,2h'e ; to Trwi
		1377	;
08EF	40	1378	ld a,2h'0 ; next intr. 1/2 bit
		1379	time
		1380	;
		1381	re-warp
		1382	;
08F0	2A	1383	ret
		1384	;
		1385	;
		1386	;
		1387	;
		1388	;
		1389	Trwi routine
		1390	;
		1391	;
		1392	;
		1393	command ?

LOC	OBJ	LINE	SOURCE STATEMENT	
		1394		
08F1	3989	1395	trmi: test vifrb,3	; command ?
08F3	6983	1396	b trmi08	; command
		1397		
		1398	next data	
		1399		
08F3	3910	1400	set spuwh,1	; to transmit mode
		1401		
08F7	3C08	1402	ld a,vlftb	
08F9	07	1403	rorc a	
08FA	3F08	1404	st a,vlftb	; data set
		1405		
08FC	41	1406	ld a,2h'1	
08FD	3F0A	1407	st a,vlfc	; counter set
		1408		
		1409	next intr.	
		1410		
08FF	C3	1411	ld h,2h'3	
ROM PAGE NO.36				
0900	E2	1412	ld l,2h'2	; to ldo
		1413		
0901	41	1414	ld a,2i	; next intr. 1 bit
		1415		time
		1416	re-warp	
		1417		
0902	2A	1418	trmi01: ret	
		1419		
		1420		
		1421	command received	
		1422		
0903	3B36	1423	trmi00: set xop06,3	; out 'space'
0905	C3	1424	ld h,2h'3	
0906	E0	1425	ld l,2h'0	; to Rdasyml
		1426		
0907	40	1427	ld a,2h'0	; next intr. 1/2 bit
		1428		time
		1429	re-warp	
		1430		
0908	82	1431	b trmi01	; to re-warp
		1432		
		1433		
		1434		
		1435		
		1436	-----	
		1437	Rdasyml routine	
		1438	-----	
		1439		
		1440		
		1441	parity, counter clear	
		1442		
0909	40	1443	rdasy: ld a,2h'0	
090A	3F0B	1444	st a,parity	
090C	3F0A	1445	st a,vlfc	; counter clear



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LOC	OBJ	LINE	SOURCE STATEMENT
		1446	;
		1447	; next intr.
		1448	;
0906	C1	1449	ld h,2h'1
090F	E4	1450	ld l,2h'4 ; to Rca
		1451	;
0910	40	1452	ld a,2h'0 ; next intr. 1/2 bi
			time
		1453	;
		1454	; re-warp
		1455	;
0911	2A	1456	ret
		1457	;
		1458	;
		1459	;
		1460	;
		1461	;
		1462	Tdo routine
		1463	;
		1464	;
		1465	;
		1466	; counter ?
		1467	;
0912	2E3A	1468	tdo: cmpr vlf,2h'3
0914	0E	1469	testp zf
0915	A3	1470	b tdo000 ; next data set
		1471	;
0916	2E7A	1472	cmpr vlf,2h'7
0918	0E	1473	testp zf
0919	A8	1474	b tdo001 ; parity set
		1475	;
		1476	; data set
		1477	;
091A	3C08	1478	ld a,vlftb
091C	07	1479	rorc a
091D	3F08	1480	st a,vlftb ; data set
		1481	;
		1482	; counter increase
		1483	;
091F	2F1A	1484	tdo002: add vlf,2h'1
		1485	;
		1486	; next intr. no change address
		1487	;
0921	41	1488	ld a,2h'1 ; next intr. 1 bit
			time
		1489	;
		1490	;
		1491	; re-warp
		1492	;
0922	2A	1493	ret
		1494	;
		1495	; counter equal 3
		1496	;
0923	3C07	1497	tdo000: ld a,vlftb
0925	3F08	1498	st a,vlftb ; transmit data rep
			lace
		1499	;
0927	9F	1500	b tdo002 ; to re-warp

LDC OBJ	LINE	SOURCE STATEMENT
	1501	;
	1502	; counter equal 7
	1503	;
0928 3C8C	1504	tp0001: ld a,paritt
092A 3F08	1505	st a,vlftb ; parity data in
	1506	;
	1507	; next intr.
	1508	;
092C C3	1509	ld h,2h'3
092D E4	1510	ld l,2h'4 ; to Tp
	1511	;
092E 41	1512	ld a,2h'1 ; next intr. 1 bit
	1513	time
	1514	; re-warp
	1515	;
092F 2A	1516	ret
	1517	;
	1518	
	1519	
	1520	
	1521	-----
	1522	Tp      routine
	1523	-----
	1524	;
	1525	;
0930 3C8D	1526	tp: ld a,lcicot
0932 3E24	1527	cmpr a,spucp
0934 8B	1528	b tp0000
	1529	;
	1530	; lci counter equals 'spucp'
	1531	;
0935 3908	1532	set vlftb,0 ; next data '1'
	1533	;
	1534	; to Tlci routine
	1535	;
0937 C3	1536	tp0001: ld h,2h'3
0938 E6	1537	ld l,2h'6 ; to Tlci
	1538	;
0939 40	1539	ld a,2h'0 ; next intr. 1/2 b
it		time
	1540	;
	1541	; re-warp
	1542	;
093A 2A	1543	ret
	1544	;
	1545	;
	1546	; lci counter not equal 'spucp'
	1547	;
093B 3948	1548	tp0000: clr vlftb,0 ; next data '0'
	1549	;
093D 87	1550	b tp0001 ; to return
	1551	;
	1552	
	1553	
	1554	
	1555	-----

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LOC	OBJ	LINE	SOURCE STATEMENT
		1556	Tlci routine
		1557	
		1558	
		1559	
093E	3950	1560	tlci: clr spuvsh,1 ; to receive mode
		1561	
		1562	
		1563	next intr.
		1564	
ROM PAGE NO. 37			
0940	C3	1565	ld h,2h'3
0941	E8	1566	ld l,2h'6 ; to Rtask
		1567	
0942	40	1568	ld a,2h'0 ; next intr. 1/2 bi
		1569	time
		1570	
		1571	re-warp
		1572	
0943	2A	1573	ret
		1574	
		1575	
		1576	
		1577	
		1578	
		1579	
		1580	Rtask routine
		1581	
		1582	
		1583	
0944	3910	1584	rtask: set spuvsh,1 ; to transmit mode
		1585	
0946	39F9	1586	testp vlfrb,3 ;
0948	AB	1587	b rtask0 ; 'nack' from ECU
		1588	
		1589	'ack' from ECU
		1590	
0949	3BF6	1591	testp %ip06,3
094B	94	1592	b rtask1 ; lci counter
		1593	equal 'spucp'
094C	3948	1594	clr vlftrb,0 ; transmit data
		1595	equal '0'
094E	3951	1596	clr spuvsh,1 ; clear 'previous
		1597	command requires
an answer'			
		1598	
		1599	next intr.
		1600	
0950	C3	1601	rtask2: ld h,2h'3
0951	EA	1602	ld l,2h'a ; to Tst
		1603	
0952	40	1604	ld a,2h'0 ; next intr. 1/2 bi
		1605	time
		1606	
		1607	re-warp

LOC	OBJ	LINE	SOURCE STATEMENT
		1608	;
0953	2A	1609	ret
		1610	;
0954	3908	1611	rtack1: set vlfth,0 ; transmit data
		1612	;
0956	3914	1613	set spuvm,1 ; equil '1'
		1614	;
		1615	transmit buffer replace ; 1200 bit timer on
		1616	;
0958	3C26	1617	ld a,writsh
095A	30	1618	xch a,h
095B	3C0D	1619	ld a,lcicot
		1620	;
095D	3801	1621	add a,2h'1
		1622	;
095F	05	1623	rolc a
0960	383E	1624	and a,2h'e
0962	31	1625	xch a,l
		1626	;
0963	0C	1627	ld a,0h1
0964	3F06	1628	st a,vlft1
0966	18	1629	inc l
0967	0C	1630	ld a,0h1
0968	3F07	1631	st a,vlft5 ; key data in
		1632	;
096A	98	1633	b rtack2
		1634	;
		1635	'neck' from ECU
		1636	;
096B	3C16	1637	rtack0: ld a,vlfec
096D	08	1638	inc a
096E	3F16	1639	st a,vlfec ; vlf error counter
		1640	;
0970	D5	1641	cmpr a,2h'5
0971	B9	1642	b rtack3 ; error not equal
		1643	;
0972	3948	1644	clr vlfth,0 ; 5'th times
		1645	;
0974	3954	1646	clr spuvm,1 ; transmit data '0'
bit clear			;
		1647	;
0976	3924	1648	set spuvm,2 ; (1200 bit timer)
n			;
		1649	;
0978	98	1650	b rtack2 ; 10sec timer bit 0
		1651	;
		1652	error not equal 5'th times ; to re-warp
		1653	;
0979	3908	1654	rtack3: set vlfth,0 ; next data '1'
		1655	;
097B	3914	1656	set spuvm,1 ; set '1200 bit tim
er bit '			;
		1657	;
097D	2FFD	1658	add lcicot,2h'f
		1659	;
097F	6950	1660	b rtack2
		1661	;

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LOC	OBJ	LINE	SOURCE STATEMENT
RDM PAGE NO.38 *			
0981	6950	1662	b rtask2 ; to re-warp
		1663	;
		1664	;
		1665	;
		1666	;
		1667	;
		1668	;
		1669	Tst routine ;
		1670	;
		1671	;
		1672	;
0983	3950	1673	tst: clr spuvsh,1 ; receive mode
		1674	;
0985	C3	1675	ld h,2h'3
0986	EC	1676	ld l,2h'c ; to Rst
		1677	;
0987	45	1678	ld a,2h'5 ; next intr. 11 bit
		1679	time
		1680	;
		1681	re-warp
		1682	;
0988	2A	1683	ret
		1684	;
		1685	;
		1686	;
		1687	Rst routine ;
		1688	;
		1689	;
		1690	;
0989	39B9	1691	rst: test vlfrb,3 ;
098B	AA	1692	b rst008 ; stop bit cann't f
ind		1693	;
098C	3BF6	1694	testp xip06,3 ;
098E	AE	1695	b rst001 ; out '0'
		1696	;
098F	3C0D	1697	ld a,lcicot
0991	08	1698	inc a
0992	3F0D	1699	st a,lcicot ; lci counter decre
ase		1700	;
0994	3910	1701	set spuvsh,1 ; to transmit mode
		1702	;
0996	3914	1703	set spuvdm,1 ; '1200 bit timr.'
		1704	;
0998	42	1705	ld a,2h'2
0999	3FF6	1706	st a,timrhn
099B	4C	1707	ld a,2h'c
099C	3FF3	1708	st a,timrhn
099E	4F	1709	ld a,2h'f
099F	3FF4	1710	st a,timrhn
		1711	;
09A1	48	1712	ld a,2h'8
09A2	3A8C	1713	out a,xopic
		1714	;

LOC	OBJ	LINE	SOURCE STATEMENT	
09A4	3940	1715	rst002: clr	spuvsh,0 ; abnormal mode
		1716		
09A6	3975	1717	clr	spuvs1,3 ; external intr.ena
ble		1718		
09A8	66DF	1719	b	r01111
		1720		
09AA	3951	1721	rst000: clr	spuvum,1
		1722		
09AC	68E0	1723	b	rcatn0 ; framing error
		1724		
		1725		
09AE	39E4	1726	rst001: testp	spuvdm,2 ; '10 sec bit' on ?
09B0	86	1727	b	rst004
		1728		
		1729		'command execute bit' on
		1730		
09B1	3934	1731	set	spuvdm,3 ;
		1732		
09B3	3951	1733	clr	spuvum,1 ; previous command
need data		1734		bit clear
09B5	A4	1735	b	rst002
		1736		
09B6	3940	1737	rst004: clr	spuvsh,0 ; abnormal mode
		1738		
		1739		10 sec timer start
		1740		
09B8	46	1741	ld	a,2h'6
09B9	3FF6	1742	st	a,timrhn
09BB	47	1743	ld	a,2h'7
09BC	3FF3	1744	st	a,timrhn
09BE	47	1745	ld	a,2h'7
09BF	3FF4	1746	st	a,timrhn
		1747		
ROM PAGE NO.39 *				
09C1	40	1748	ld	a,2h'0
09C2	3A8C	1749	out	a,%oplc
		1750		
09C4	49	1751	ld	a,2h'9
09C5	3A8C	1752	out	a,%oplc ; start
		1753		
09C7	3954	1754	clr	spuvdm,1 ; 1200 bit timer bi
		1755		clear
09C9	66DF	1756	b	r01111 ; return
		1757		
		1758		
		1759		
		1760		
		1761		
		1762		
		1763		
		1764		
		1765		
		1766		

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LOC OBJ LINE SOURCE STATEMENT

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```

0A00      1767      org      h'a00
           1768 ;
           1769 ; re-warp
           1770 ;
0A00 D0     1771      cmpr     a,2h'0
0A01 0E     1772      testp    zf
0A02 9B     1773      b        rwarpc0      ; next intr. 1/2 bit
           1774 ;                               time
0A03 D1     1775      cmpr     a,2h'1
0A04 0E     1776      testp    zf
0A05 A4     1777      b        rwarpc1      ; next intr. 1 bit
           1778 ;                               time
0A06 D2     1779      cmpr     a,2h'2
0A07 0E     1780      testp    zf
0A08 AD     1781      b        rwarpc2      ; next intr. 6 bit
           1782 ;                               time
0A09 D3     1783      cmpr     a,2h'3
0A0A 0E     1784      testp    zf
0A0B B7     1785      b        rwarpc3      ; next intr. 9 bit
           1786 ;                               time
           1787 ;
           1788 ; 11 bit timer
           1789 ;
0A0C 4F     1790      ld        a,2h'f
0A0D 3F1B   1791      st        a,timrho
0A0F 47     1792      ld        a,2h'7
0A10 3F1A   1793      st        a,timrho
0A12 4C     1794      ld        a,2h'c
0A13 3F19   1795      st        a,timrho
           1796 ;
           1797 ; next warp
           1798 ;
0A15 29C4   1799 rwarpc4: xch     hl,warpc1
0A17 2BC4   1800      ld        hl,warpc1
           1801 ;
0A19 66DF   1802      b        r01111      ; return
           1803 ;
           1804 ;
           1805 ; 1/2 bit timer
           1806 ;
0A1B 4F     1807 rwarpc0: ld      a,2h'f
0A1C 3F1B   1808      st        a,timrho
0A1E 3F1A   1809      st        a,timrho
0A20 4A     1810      ld        a,2h'a
0A21 3F19   1811      st        a,timrho
           1812 ;
0A23 93     1813      b        rwarpc4
           1814 ;
           1815 ; 1 bit timer
           1816 ;
0A24 4F     1817 rwarpc1: ld      a,2h'f
0A25 3F1B   1818      st        a,timrho

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LDC OBJ	LINE	SOURCE STATEMENT
0A27 3F1A	1819	st a,timrno
0A29 44	1820	ld a,2h'4
0A2A 3F19	1821	st a,timrlo
0A2C 95	1822 ;	
	1823	b rward4
	1824 ;	
	1825 ;	
	1826 ;	6 bit timer
	1827 ;	
0A2D 4F	1828	rward2: ld a,2h'f
0A2E 3F1B	1829	st a,timrno
0A30 4B	1830	ld a,2h'b
0A31 3F1A	1831	st a,timrno
0A33 4B	1832	ld a,2h'b
0A34 3F19	1833	st a,timrlo
	1834 ;	
0A36 95	1835	b rward4
	1836 ;	
	1837 ;	9 bit timer
	1838 ;	
0A37 4F	1839	rward3: ld a,2h'f
0A38 3F1B	1840	st a,timrno
0A3A 49	1841	ld a,2h'9
0A3B 3F1A	1842	st a,timrno
0A3D 44	1843	ld a,2h'4
0A3E 3F19	1844	st a,timrlo
	1845 ;	

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0A40 6A15	1846	b rward4
	1847 ;	
	1848	end

ASSEMBLY COMPLETE, 0 PROGRAM ERROR(S)



## SYMBOL TABLE

COMMAD	0013	COMMAH	0015	COMMAL	0014	* DART0H	0081
* DATA0L	0080	* DATA1H	0083	* DATA1L	0082	* DATA2H	0085
* DATA2L	0084	* DATA3H	0087	* DATA3L	0086	* DATA4H	0089
* DATA4L	0088	* DATACT	0200	DCH	00FE	DCL	00FC
DCM	00FD	* DISPA	0032	* DISPH	0031	* DISPIH	0034
* DISPL	0030	* DISPLW	0033	FRAME	0053	INCOTH	008C
INCOTL	008A	INCOTM	008B	* IOVF1	0002	* KEST	0022
KEST0H	0043	KEST0L	0042	* KEST1H	0045	* KEST1L	0044
* KEST2H	0047	* KEST2L	0046	* KEST3H	0049	* KEST3L	0048
* KEST4H	0048	* KEST4L	004A	* KEST5H	004D	* KEST5L	004C
* KESTBH	0021	* KESTBL	0020	* KEYND	0029	* KEYNN	002A
* KEYOD	002B	* KEYON	002C	* KEYS	0100	* KEYSB	0250
* KEYSO	000E	* KEYT	0300	* KEYTB	00C8	LCICOT	000D
* LDATL1	0037	* LDATL2	0038	* LDATM1	0035	* LDATM2	0036
* LDISP	0000	* LECOTH	008F	* LECOTL	008D	* LECOTM	008E
* LIOVF2	0000	* LMAIN	03E0	* LREM0	0000	* LTABLE	0000
* LVLFEH	0000	* OVER2A	0072	* OVER2H	0071	* OVER2L	0070
OVERA1	0012	* OVERH1	0011	OVERL1	0010	PARITT	000C
PARITY	000B	R0	06B2	R00000	06C2	R00001	06C1
R01000	06C9	* R01100	06CE	R01110	06EA	R01111	06DF
RCA	0719	ACA000	0734	ACA001	073A	RCA002	0732
RCA003	0733	RCF	073E	RCF000	074F	RCF001	0754
RCF002	074D	RCF005	0776	RCF006	074E	RCF100	077C
RCF110	0785	RCF111	07CF	RCF120	0798	RCF121	07AE
RCF122	07A9	RCP	07D4	RCP000	07E9	RCP003	07E3
* RCP004	07E3	RCP100	07E1	* RCSTA1	0839	RCSTAB	0838
RCSTN	07FA	RCSTN0	0820	RCSTN1	0817	* RCSTN2	0805
RCSTN3	0813	RCSTN6	0803	RCSTN7	0831	RDAMY	0909
RDAST	0885	RDAST1	08A8	RDAST3	08A4	RDAST4	08AE
RDAST5	08B8	RDAST6	088C	RDD	0841	RDD000	0858
RDD001	0860	RDD002	0857	RDP	0871	RDP000	087C
RDP001	0876	READC	0028	READN	0027	* REMD0	0060
* REMD1	0061	* REMD2	0062	* REMD3	0063	* REMD4	0064
* REMD5	0065	* REMD6	0066	* REMD7	0067	* REMD8	006A
* REMOH	0069	* REMOL	0068	RKCE	0050	RMI	06FC
RMI000	070F	RMI001	0709	RMI002	070E	RMI003	0715
* RNH	006B	* RNL	006D	* RNM	006C	RST	0989
RST000	09AA	RST001	09AE	RST002	09A4	RST004	0986
RSTD	0834	RTACK	0944	RTACK0	096B	RTACK1	0954
RTACK2	0950	RTACK3	0979	RWARP0	0A1B	RWARP1	0A24
RWARP2	0A2D	RWARP3	0A37	RWARP4	0A15	* RWRPCH	00CA
* RWRPCL	00C8	* RWRPCH	00C9	SERVC	000F	SPUCP	0024
SPUFF	0017	SPUSH	0003	SPUSH	0023	SPUSL	0002
SPUTT	0018	SPUVDH	0004	SPUVDH	0000	SPUVDL	0005
SPUVDH	0001	SPW	00FF	SPWB	00C7	T0	08C2
T00000	08D4	TD1	08E9	TDACK	087F	TDD	0912
TDD000	0923	TDD001	0928	TDD002	091F	* TIMR2H	00FA
* TIMR2L	00F8	* TIMR2H	00F9	TIMRHN	00F6	TIMRHO	001B
TIMRLN	00F4	TIMRLO	0019	TIMRMN	00F5	TIMRMO	001A
TLCI	093E	TP	0930	TP0000	093B	TP0001	0937
TRA	07EE	TRA000	07F7	TRA001	07F5	TRMI	08F1
TRMI00	0903	TRMI01	0902	TST	0983	VL0040	06A3
VL0050	0698	VL0060	0689	VLFB01	0635	VLFB02	0647
VLFB03	0654	VLFB04	066E	VLFB05	0640	VLFB10	0623

## SYMBOL TABLE

VLFD11	062B	VLFI00	061E	VLFD00	062D	VLFI300	06AD
VLFC	060A	VLFE0	0616	VLFR0	0609	VLFTB	0608
VLFTH	0607	VLFTL	0606	• VLFXA	0632	• VLFXH	0631
• VLFXL	0630	WARPCL	06C4	• WAPPCM	06C3	WRITEN	0625
WRITEN	0623						

DEFINED 233 USER SYMBOL(S)

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PAGE 1

LOC	OBJ	LINE	SOURCE STATEMENT
		1	
		2	7.1983.
		3	lvlfex.asm V1.0
		4	(TMP4740P)
		5	
		6	vlf communication routine
		7	
		8	
		9	
			snolist
			slist
		303	
		304	
		305	
ROM PAGE NO.48			
0C00		306	org h'c00
		307	
		308	disable ?
		309	
0C00 39F5		310	vlfex: testp spuvs1,3
0C02 6C42		311	b vlfx00 ; 1'st intr. disabl
		312	
		313	push register
		314	
0C04 3F52		315	st a,vlfxa
0C06 2950		316	xch hl,vlfxl ; push register
		317	
		318	clear external counter
		319	
0C08 40		320	ld a,Zh'0
0C09 3A8C		321	out a,Xoplc
0C0B 3B04		322	set Xop04,0
0C0D 3B44		323	clr Xop04,0 ; event timer start
		324	
		325	timer start
		326	
0C0F 3CF6		327	ld a,timrhn
0C11 3F8C		328	st a,inc0th
0C13 3CF5		329	ld a,timrmn
0C15 3F8B		330	st a,inc0tn
0C17 3CF4		331	ld a,timrln
0C19 3F8A		332	st a,inc0tl
		333	
0C1B 4F		334	ld a,Zh'f
0C1C 3FF6		335	st a,timrhn
0C1E 3FF5		336	st a,timrmn

LOC	OBJ	LINE	SOURCE STATEMENT	
0C20	4A	337	ld a,2h'a	
0C21	3FF4	338	st a,timrln	
0C23	44	339	ld a,2h'4	
0C24	3A8C	340	out a,xoplc	; timer start
		341		( 1/2 bit time )
		342	; framing error ?	
		343		
0C26	39F1	344	testp spuvsb,3	
0C28	6C43	345	b vlfxb01	; framing error
		346		
		347	; mode change from abnormal to normal	
		348		
0C2A	3900	349	set spuvsb,0	; to normal mode
		350		
		351	; transmit ?	
		352		
0C2C	39D0	353	testp spuvsb,1	
0C2E	6C37	354	b vlfxb02	; transmit mode
		355		
		356	; next routine	
		357		
0C30	40	358	ld a,2h'0	
0C31	3FC4	359	st a,warpc1	
0C33	41	360	ld a,2h'1	
0C34	3FC5	361	st a,warpcw	; address h'010
		362		
		363	; next timer setting	
		364		
0C36	4F	365	ld a,2h'f	
0C37	3F1B	366	st a,timrhc	
0C39	3F1A	367	st a,timrhc	
0C3B	44	368	ld a,2h'4	
0C3C	3F19	369	st a,timrhc	
		370		
		371	; pop register	
		372		
0C3E	3C52	373	vlfxb03: ld a,vlfxb	
ROM PAGE NO.49				
0C40	2950	374	xch hl,vlfxb	
		375		
		376	; return	
		377		
0C42	2B	378	vlfxb00: reti	
		379		
		380		
		381	; framing error	
		382		
0C43	00	383	vlfxb01: nop	
0C44	4F	384	ld a,2h'f	
0C45	3F1B	385	st a,spuvsb	
		386		
		387	ld a,2h'f	
		388	st a,timrhc	

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CP/M TLC8-47 ASSEMBLER V2.2

PAGE 3

LOC	OBJ	LINE	SOURCE STATEMENT
		389	ld a,2h'7
		390	st a,tiermn
		391	ld a,2h'c
		392	st a,tierln
		393	
		394	ld a,2h'4
		395	out a,%oplc ; timer start 11 bi
t			time
		396	
0C47	3C8C	397	ld a,incoth
0C49	3F1B	398	st a,tierho
0C4B	3C8B	399	ld a,incotn
0C4D	3F1A	400	st a,tiermo
0C4F	3C8A	401	ld a,incotl
0C51	3F19	402	st a,tierlo
		403	
0C53	3B36	404	set %op06,3
		405	
0C55	6C3E	406	b vlfx03
		407	
		408	
		409	transmit mode
		410	
0C57	3B76	411	vlfx02: clr %op06,3 ; out 'mark'
		412	
0C59	3C86	413	ld a,vlftl
0C5B	3F08	414	st a,vlftb ; transmit buffer
		415	clear
0C5D	4F	416	ld a,2h'f
0C5E	3F1B	417	st a,tierho
0C60	3F1A	418	st a,tiermo
0C62	4A	419	ld a,2h'a
0C63	3F19	420	st a,tierlo ; timer set
		421	
0C65	42	422	ld a,2h'2
0C66	3FC5	423	st a,%arpcm
0C68	4A	424	ld a,2h'a
0C69	3FC4	425	st a,%arpc1 ; next routin
		426	
0C6B	6C3E	427	b vlfx03 ; to return
		428	
		429	
		430	end

ASSEMBLY COMPLETE,

0 PROGRAM ERROR(S)

## SYMBOL TABLE

* COMRAD	0013	* COMRAH	0015	* COMMAL	0014	* DATA0H	0081
* DATA0L	0080	* DATA1H	0083	* DATA1L	0082	* DATA2H	0085
* DATA2L	0084	* DATA3H	0087	* DATA3L	0086	* DATA4H	0089
* DATA4L	0088	* DATACT	0200	* DCH	00FE	* DCL	00FC
* DCM	00FD	* DISPA	0032	* DISPH	0031	* DISPIW	0034
* DISPL	0030	* DISPLW	0033	* FLASH	0350	* INCOTH	008C
* INCOTL	008A	* INCOTW	008B	* KEYT	0022	* KEST0H	0043
* KEST0L	0042	* KEST1H	0045	* KEST1L	0044	* KEST2H	0047
* KEST2L	0046	* KEST3H	0049	* KEST3L	0048	* KEST4H	004B
* KEST4L	004A	* KEST5H	004D	* KEST5L	004C	* KESTBH	0021
* KESTBL	0020	* KEYND	0029	* KEYNM	002A	* KEYOD	002B
* KEYON	002C	* KEYS	0100	* KEYSB	0250	* KEYSO	000E
* KEYT	0300	* KEYTB	00C9	* LCICOT	000D	* LDASL1	003B
* LDASL2	003C	* LDASM1	0039	* LDASM2	003A	* LDATL1	0037
* LDATL2	0038	* LDATM1	0035	* LDATM2	0036	* LDISP	0000
* LECOTH	008F	* LECOTL	008D	* LECOTM	008E	* LEDD	0310
* LIOVF1	0600	* LIOVF2	0D00	* LMAIN	03E0	* LREM0	0E00
* LTABLE	0000	* LVLFEY	0C00	* OVER2A	0072	* OVER2H	0071
* OVER2L	0070	* OVERA1	0012	* OVERH1	0011	* OVERL1	0010
* PARITY	000C	* PARITY	000B	* READC	0028	* READN	0027
* REMD0	0060	* REMD1	0061	* REMD2	0062	* REMD3	0063
* REMD4	0064	* REMD5	0065	* REMD6	0066	* REMD7	0067
* REMDA	006A	* REMDH	0069	* REMOL	0068	* RKCE	0050
* RNH	006B	* RNL	006D	* RNH	006C	* RWRPCH	00CA
* RWRPCL	00C8	* RWRPCM	00C9	* SERVRC	000F	* SPUCP	0024
* SPUSH	0003	* SPUSH	0023	* SPUBL	0002	* SPUTT	0018
* SPUVDM	0004	* SPUVSH	0000	* SPUVSL	0005	* SPUVUM	0001
* SPW	00FF	* SPWB	00C7	* TIMR2H	00FA	* TIMR2L	00F8
* TIMR2M	00F9	* TIMRMH	00F6	* TIMRHO	0019	* TIMRLN	00F4
* TIMRLO	0019	* TIMRMN	00F5	* TIMRMO	001A	* VLFC	000A
* VLFEY	0016	* VLFEX	0C00	* VLFRB	0009	* VLFTB	0008
* VLFTH	0007	* VLFTL	0006	* VLFX00	0C42	* VLFX01	0C43
* VLFX02	0C57	* VLFX03	0C3E	* VLFXA	0052	* VLFXH	0051
* VLFXL	0050	* WARPCL	00C4	* WAPPCM	00C3	* WRITEN	0026
* WRITEN	0025						

DEFINED 137 USER SYMBOL(S)

LOC	OBJ	LINE	SOURCE STATEMENT
1			
2			
3			lremo.asm V1.0
4			(TMP4740P)
5			
6			remote. routine
7			
8			
9			

snolist

slist

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ROM PAGE NO.56

0E00	259	org	h'e00
	260		
	261		
	262		r escape
	263		
0E00 3F6A	264	st	a,remoa
0E02 44	265	ld	a,210100b
0E03 13	266	xch	a,eir
0E04 366F	267	exclr	il,101111b
0E06 2968	268	xch	hl,remol
	269		
	270		to stop timer2
	271		
0E08 40	272	ld	a,20
0E09 3A8D	273	out	a,%opld
	274		check N1
	275		
0E0B 3C6B	276	ld	a,rnh
0E0D D3	277	cmpr	a,2h'3
0E0E 0E	278	testp	zf
0E0F 6E5C	279	b	int100
	280		
0E11 D2	281	cmpr	a,22
0E12 0E	282	testp	zf
0E13 A4	283	b	int200
	284		
	285		N1=1 or 0
0E14 41	286	ld	a,21
0E15 3F6B	287	st	a,rnh
	288		
	289		setting timer2 on 4.5ms
	290		
0E17 4F	291	ld	a,2h'f

LOC	OBJ	LINE	SOURCE STATEMENT
0E18	3FFA	292	st a,timr2h
0E1A	4E	293	ld a,2h'0
0E1B	3FF9	294	st a,timr2m
0E1D	3FF8	295	st a,timr2l
		296 ;	
0E1F	48	297	ld a,28
0E20	3A8D	298	out a,xopld
0E22	6EE7	299	b ret2
		300 ;	
		301 ;;;	N1=2
		302 ;	
0E24	3CF8	303	int200: ld a,timr2l ; timer check
0E26	3802	304	add a,2h'2
0E28	05	305	rolc a
0E29	04	306	testp cf ;
0E2A	BE	307	b int210 ;jump on carry '1'
		308 ;	
		309 ;;	setting timer2
		310 ;	
0E2B	3B06	311	in2000: set %op06,0
		312 ;	
0E2D	4E	313	ld a,2h'0
0E2E	3FFA	314	st a,timr2h
0E30	47	315	ld a,2h'7
0E31	3FF9	316	st a,timr2m
0E33	4C	317	ld a,2h'c
0E34	3FF8	318	st a,timr2l
		319 ;	
0E36	48	320	ld a,28
0E37	3A8D	321	out a,xopld ;start
		322 ;	
0E39	48	323	ld a,28
0E3A	3F6B	324	st a,rnh ;N1=0
		325 ;	
0E3C	6EE7	326	b ret2
		327 ;	
		328 ;;	start data receive
		329 ;	
0E3E	3CF9	330	int210: ld a,timr2m
ROM PAGE NO. 57			
0E40	DF	331	cmpr a,2h'f
0E41	6E2B	332	b in2000
		333 ;	
0E43	43	334	ld a,23
0E44	3F6B	335	st a,rnh ;N1=3
		336 ;	
		337 ;	ram clear
		338 ;	
0E46	C6	339	ld h,26
0E47	E0	340	ld l,20
		341 ;	
0E48	11	342	mov l,a
		343 ;	



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PAGE 3

LOC	OBJ	LINE	SOURCE STATEMENT
0E49	0F	344	int211: st a,0h1
0E4A	18	345	inc l
0E4B	3898	346	cmpr l,28
0E4D	0E	347	testp zf
0E4E	90	348	b int212
0E4F	89	349	b int211
		350	;
		351	setting timer2
		352	;
0E50	3FF8	353	int212: st a,timr21
0E52	4F	354	ld a,2h'f
0E53	3FF9	355	st a,timr2m
0E55	3FFA	356	st a,timr2h
		357	;
0E57	48	358	ld a,28
0E58	3A8D	359	out a,%opld
		360	;
0E5A	6EE7	361	b ret2
		362	;
		363	data receive
		364	;
		365	int100: ld a,rnm
0E5C	3C6C	366	xch a,l ;l ← N2
0E5E	31	367	;
0E5F	C6	368	ld h,25
		369	;
0E60	3CF8	370	ld a,timr21
		371	;
0E62	3809	372	add a,29
		373	;
0E64	6EB7	374	b int130 ;carry '0'
		375	;
0E66	3C6D	376	int110: ld a,rnl ;a(000 N3
0E68	D0	377	cmpr a,20 ;N3=0 ?
0E69	0E	378	testp zf
0E6A	B8	379	b int121
		380	;
0E6B	D1	381	cmpr a,21 ;N3=1 ?
0E6C	0E	382	testp zf
0E6D	BE	383	b int122
		384	;
0E6E	D2	385	cmpr a,22 ;N3=2 ?
0E6F	0E	386	testp zf
0E70	6E83	387	b int123
		388	;
		389	N3=3 I J*12
0E72	0C	390	ld a,0h1
0E73	3821	391	or a,21
0E75	0F	392	st a,0h1
0E76	6EB7	393	b int130
		394	;
0E78	0C	395	int121: ld a,0h1
0E79	3828	396	or a,28
0E7B	0F	397	st a,0h1
0E7C	6EB7	398	b int130

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CP/M TLC3-47 ASSEMBLER V2.2

PAGE 4

LOC	OBJ	LINE	SOURCE STATEMENT
		399	;
0E7E	0C	400	int122: ld a,0h1
0E7F	3824	401	or a,24
ROM PAGE NO.56 *			
0E81	0F	402	st a,0h1
0E82	87	403	b int130
		404	;
0E83	0C	405	int123: ld a,0h1
0E84	3822	406	or a,22
0E86	0F	407	st a,0h1
		408	;
0E87	3C6D	409	int130: ld a,rn1
0E89	3801	410	add a,21
0E8B	3F6D	411	st a,rn1
		412	;
0E8D	04	413	cmpr a,24
0E8E	9B	414	b int140 ;jump on N3(4
		415	;
0E8F	40	416	ld a,20
0E90	3F6D	417	st a,rn1 ; N3(--- 0
		418	;
0E92	3C6C	419	ld a,rn1
0E94	3801	420	add a,21 ;a(--- N2+1
0E96	3F6C	421	st a,rn1
		422	;
0E98	08	423	cmpr a,20
0E99	0E	424	testp zf
0E9A	A8	425	b int150 ;jump N2-8
		426	;
		427	setting timer2.
		428	;
0E9B	4F	429	int140: ld a,2h'f
0E9C	3FFA	430	st a,timr2h
0E9E	3FF9	431	st a,timr2m
0EA0	40	432	ld a,20
0EA1	3FF8	433	st a,timr2l
		434	;
0EA3	48	435	ld a,28
0EA4	3A8D	436	out a,%opld
0EA6	6EE7	437	b ret2
		438	;
		439	;; data check & convert
		440	;; check code was complete or not
		441	;
0EAB	E0	442	int150: ld 1,20
0EAC	0C	443	ld a,0h1
		444	;
0EAA	D1	445	cmpr a,21
0EAB	6EE0	446	b int160
		447	;
0EAD	E3	448	ld 1,23
		449	;
0EAE	0C	450	ld a,0h1

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CP/M TLCS-47 ASSEMBLER V2.2

PAGE 5

LOC	OBJ	LINE	SOURCE STATEMENT
		451 ;	
0EAF DD		452	cmpr a,2h'd
0EB0 6EE0		453	b int160 ;received data was error
		454 ;	
		455 ;	check data was complete or not
		456 ;	
0EB2 4F		457	ld a,2h'f
		458 ;	
0EB3 E7		459	ld 1,E7
		460 ;	
0EB4 1F		461	xor a,0h1
		462 ;	
0EB5 E5		463	ld 1,E5
		464 ;	
0EB6 16		465	cmpr a,0h1
0EB7 6EE0		466	b int160 ;data was not complete
		467 ;	
		468 ;	data convert
		469 ;	
0EB9 0C		470	ld a,0h1
		471 ;	
0EBA D0		472	cmpr a,E0
0EBB 0E		473	testp zf
0EBC 6EC2		474	b int171 ;
		475 ;	
0EBE 4C		476	ld a,2h'c
0EBF 3FFD		477	st a,dcm ;data counter setting
ROM PAGE NO.59 *			
0EC1 85		478	b int172
		479 ;	
0EC2 4D		480	int171: ld a,2h'd
0EC3 3FFD		481	st a,dcm ;data countersetting
		482 ;	
0EC5 19		483	int172: dec 1 ;1(--- 24
		484 ;	
0EC6 0C		485	ld a,0h1
		486 ;	
0EC7 3FFC		487	st a,dcl ;data counter setting
		488 ;	
0EC9 4F		489	ld a,2h'f
0ECA 3FFE		490	st a,dch ; data counter setting
		491 ;	
		492 ;	
0ECC 33		493	ldl a,0dc
0ECD 31		494	xch a,l
		495 ;	
0ECE 32		496	ldh a,0dc+
0ECF 30		497	xch a,h
		498 ;	
0ED0 2250		499	call keyab
		500 ;	
0ED2 3930		501	set spuvsb,3 ; remote flag on
		502 ;	

LOC	OBJ	LINE	SOURCE STATEMENT
		503 ;	setting timer2
0ED4	4F	504	ld a,2h'f
0ED5	3FFA	505	st a,h'fa
0ED7	43	506	ld a,2h'3
0ED8	3FF9	507	st a,h'f9
0EDA	40	508	ld a,2h'0
0EDB	3FF8	509	st a,h'f8
		510 ;	
0EDD	40	511	ld a,20
0EDE	3A8D	512	out a,%opid ;
		513 ;	
		514 ;	N(—0
		515 ;	
0EE0	40	516	int160: ld a,20
0EE1	3F6B	517	st a,rnh
0EE3	3F6C	518	st a,rns
0EE5	3F6D	519	st a,rnl
		520 ;	
		521 ;	return routine
		522 ;	
0EE7	2968	523	ret2: xch hl,remol
0EE9	47	524	ld a,20111b
0EEA	36AF	525	dielr 11,101111b
0EEC	13	526	xch a,sir
0EED	3C6A	527	ld a,remoa
		528 ;	
0EEF	3B46	529	clr %op06,0
		530 ;	
0EF1	2B	531	reti
		532 ;	
		533 ;	
		534 ;	
		535 ;	
		536	end

ASSEMBLY COMPLETE. 0 PROGRAM ERROR(S)

## SYMBOL TABLE

* COMAD	0013	* COMMFC	0015	* COMMR	0014	* DATACT	0200
DCM	00FE	DCL	00FC	DCM	00FD	* DISPR	0032
* DISPH	0031	* DISPIW	0034	* DISPL	0030	* DISPLW	0033
INT000	0E2B	* INCOTL	003B	* INCOTL	0039	* INCOTM	003A
INT100	0E5C	* INT110	0E66	INT121	0E78	INT122	0E7E
INT123	0E83	INT130	0E87	INT140	0E9B	INT150	0EA8
INT160	0EE0	INT171	0EC2	INT172	0EC5	INT200	0E24
INT210	0E3E	INT211	0E49	INT212	0E50	* KEST	0043
* KEST0H	0023	* KEST0L	0022	* KEST1H	0025	* KEST1L	0024
* KEST2H	0027	* KEST2L	0026	* KEST3H	0029	* KEST3L	0028
* KEST4H	002B	* KEST4L	002A	* KESTBH	0041	* KESTBL	0040
* KEYND	002C	* KEYNN	002D	* KEYOD	002E	* KEYON	002F
* KEYS	0100	* KEYSB	0250	* KEYSO	000E	* KEYSB	00CB
* LCICOT	000D	* LDATL1	0037	* LDATL2	0038	* LDATM1	0035
* LDATM2	0036	* LDISP	0000	* LECOTM	003E	* LECOTL	003C
* LECOTM	003D	* LIOVF1	0600	* LIOVF2	0000	* LMAIN	03E0
* LTABLE	0000	* LVLFEY	0C00	* OVERA1	0012	* OVERH1	0011
* OVERL1	0010	* PARITT	000C	* PARITY	000B	* REMD0	0060
* REMD1	0061	* REMD2	0062	* REMD3	0063	* REMD4	0064
* REMD5	0065	* REMD6	0066	* REMD7	0067	REMDA	006A
* REMOH	0069	REMOI	0068	RET2	0EE7	* RXCE	0050
RNH	006B	RNL	006D	RNM	006C	* RWRPCH	00CA
* RWRPCL	00C8	* RWRPCM	00C9	* SERVRC	000F	* SPUCP	0021
* SPUSH	0003	* SPUSK	0020	* SPUSL	0002	* SPVDM	0004
* SPVSH	0000	* SPVSL	0005	* SPVUM	0001	* SPW	00FF
* SPWB	00C7	TIMR2H	00FA	TIMR2L	00F8	TIMR2M	00F9
* TIMRHN	00F6	* TIMRHO	001B	* TIMRLN	00F4	* TIMRLD	0019
* TIMRMN	00F5	* TIMRMO	001A	* VDATAH	0018	* VDATAI	0017
* VLFC	000A	* VLFEY	0016	* VLFRB	0009	* VLFTB	0008
* VLFTH	0007	* VLFTL	0006	* VLFXA	0052	* VLFXH	0051
* VLFXL	0050	* WARPCL	00C4	* WARPCM	00C5		

DEFINED 123 USER SYMBOL(S)

LOC	OBJ	LINE	SOURCE STATEMENT
-----	-----	------	------------------

1	:		
2	:		7.1983.
3	:	subroutine	V1.0
4	:		(TMP4740P)
5	:		
6	:		
7	:		
8	:		

enolist

olist

289 ;

ROM PAGE NO. 1

0050	290	org	h'050	
	291	:		
0050 3C17	292	rkce1	ld	a,spuff
0052 DF	293	cmpr	a,2h'f	
0053 98	294	b	rkce5	
	295	:		
0054 40	296	ld	a,2h'0	
0055 3F17	297	st	a,spuff	
0057 AB	298	b	rkce4	; to return
	299	:		
0058 3C23	300	rkce5:	ld	a,spusk
005A 3E24	301	cmpr	a,spucp	
005C AC	302	b	rkce0	; branch on
	303	:		spusk()spucp
005D 394F	304	clr	servrc,0	; clear service req
uest				
	305	:		
005F 3942	306	clr	spual,0	; new character ava
ilable				
	307	:		
0061 4F	308	ld	a,2h'f	
0062 3F42	309	st	a,kest01	
0064 3F43	310	st	a,kest0h	; no keystroke
	311	:		
	312	:	spusk,spucp	clear
	313	:		
0066 40	314	ld	a,2h'0	
0067 3F23	315	st	a,spusk	
0069 3F24	316	st	a,spucp	
	317	:		
	318	:	return	
	319	:		
006B 2A	320	rkce4:	ret	
	321	:		
	322	:		
	323	:	buffer	

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CP/M TLC9-47 ASSEMBLER V2.2

PAGE 2

LOC	OBJ	LINE	SOURCE STATEMENT
		324 ;	
005C	3C24	325 rkce0:	ld a,spucp
005E	08	326	inc a
005F	3F0E	327	st a,keysc
		328 ;	
0071	3C0E	329 rkce1:	ld a,keysc
0073	05	330	rolc a
0074	383E	331	and a,\$1110b
		332 ;	
0076	31	333	xch a,l
0077	C4	334	ld h,\$h'4
		335 ;	
0078	0C	336 rkce2:	ld a,\$hl
		337 ;	
0079	388E	338	add l,\$h'e ; l ← l-2
		339 ;	
007B	0F	340	st a,\$hl
		341 ;	
007C	3883	342	add l,\$h'3 ; l ← l+3
		343 ;	
007E	0C	344	ld a,\$hl
		345 ;	
007F	388E	346 rkce3:	add l,\$h'e ; l ← l-2
		347 ;	
ROM PAGE NO. 2 *			
0081	0F	348	st a,\$hl
		349 ;	
0082	3883	350	add l,\$h'3
		351 ;	
0084	389C	352	cmpr l,\$h'c ; buffer bottom ?
0085	6078	353	b rkce2
		354 ;	
0088	2FFE	355	add keysc,\$h'f ; keysc ← keysc-1
		356 ;	
008A	2E1E	357	cmpr keysc,\$h'1
008C	6071	358	b rkce1
		359 ;	
		360 ;	spusk ← ( spusk-spucp )
		361 ;	
008E	04	362	testp cf ; cf ← 1
		363 ;	
008F	C2	364	ld h,\$h'2
0090	E3	365	ld l,\$h'3 ; spusk = m( hl )
		366 ;	
0091	3C24	367	ld a,spucp
		368 ;	
0093	14	369	subrc a,\$hl ; spusk-spucp
		370 ;	
0094	0F	371	st a,\$hl
		372 ;	
0095	40	373	ld a,\$h'0
0096	3F24	374	st a,spucp ; spucp ← 0
		375 ;	

LOC	OBJ	LINE	SOURCE STATEMENT
0098	6068	376	b rkey4 ; to return
		377	;
		378	;
		379	;
RDM PAGE NO. 4			
0100		380	org h'100
		381	;
0100	4F	382	keya: ld a, zh'f
0101	3F0E	383	st a, keysc
0103	3F29	384	st a, keynd
		385	;
0105	E0	386	ld l, zh'0
0106	4E	387	ld a, zh'e
		388	;
0107	3A05	389	key001: out a, %op05
		390	;
0109	2300	391	call keyt ; timer
		392	;
010B	30	393	xch a, h
		394	;
010C	3A27	395	in %ip07, a
		396	;
010E	DF	397	cmpr a, zh'f
010F	0E	398	testp zf
0110	98	399	b key002
		400	;
0111	10	401	inc l
0112	3F29	402	st a, keynd
0114	3C0E	403	ld a, keysc
0116	3F2A	404	st a, keynn
		405	;
0118	2F1E	406	key002: add keysc, 21
011A	2E3E	407	cmpr keysc, zh'3
011C	B2	408	b key003
		409	;
011D	2CF3	410	out zh'f, %op05
011F	3B74	411	clr %op04, 3
		412	;
0121	2300	413	call keyt
		414	;
0123	3A27	415	in %ip07, a
0125	3B34	416	set %op04, 3
		417	;
0127	DF	418	cmpr a, zh'f
0128	0E	419	testp zf
0129	B6	420	b key004
		421	;
012A	10	422	inc l
012B	3F29	423	st a, keynd
012D	3C0E	424	ld a, keysc
012F	3F2A	425	st a, keynn
0131	B6	426	b key004
		427	;



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PAGE 4

LOC	OBJ	LINE	SOURCE STATEMENT
0132	30	428	key003: xch a,h
0133	05	429	rolc a
0134	87	430	b key001
0135	87	431	b key001
		432	;
0136	30	433	key004: xch a,h
0137	3C29	434	ld a,keynd
		435	;
0139	DF	436	cmpr a,2h'f
013A	0E	437	testp zf
013B	617D	438	b key005
		439	;
013D	3891	440	cmpr l,2h'1
013F	0E	441	testp zf
			;
ROM PAGE NO. 5			
0140	82	442	b key020
0141	B3	443	b key006
		444	;
0142	3C29	445	key020: ld a,keynd
		446	;
0144	DE	447	cmpr a,2h'e
0145	0E	448	testp zf
0146	91	449	b key021
		450	;
0147	DD	451	cmpr a,2h'd
0148	0E	452	testp zf
0149	91	453	b key021
		454	;
014A	DB	455	cmpr a,2h'b
014B	0E	456	testp zf
014C	91	457	b key021
		458	;
014D	D7	459	cmpr a,2h'7
014E	0E	460	testp zf
014F	91	461	b key021
0150	B3	462	b key006
		463	;
0151	3C29	464	key021: ld a,keynd
0153	3E29	465	cmpr a,keynd
0155	A8	466	b key007
		467	;
0156	3C2C	468	ld a,keyon
0158	3E2A	469	cmpr a,keymn
015A	A8	470	b key007
		471	;
015B	39E0	472	testp spuvsb,2
015D	B8	473	b key022
		474	;
		475	;
015E	39B5	476	key030: test spuvs1,0
0160	B2	477	b key010
		478	;
		479	;

LOC	OBJ	LINE	SOURCE	STATEMENT
0161	2200	480	call	dataact
		481		
0163	2230	482	call	keysb
		483		
		484		
0165	3945	485	clr	spuvs1,0
0167	AA	486	b	key008
		487		
0168	3985	488	key007: set	spuvs1,0
		489		
016A	3C29	490	key008: ld	a, keynd
016C	3F2B	491	st	a, keyod
016E	3C2A	492	ld	a, keynn
0170	3F2C	493	st	a, keyon
		494		
		495		
0172	2A	496	key010: ret	(return
		497		
0173	3945	498	key006: clr	spuvs1,0
0175	3920	499	set	spuvsh,2
0177	AA	500	b	key008
		501		
0178	3985	502	key022: set	spuvs1,0
017A	3960	503	clr	spuvsh,2
017C	AA	504	b	key008
		505		
		506		
		507		
017D	3C2B	508	key005: ld	a, keyod
		509		
017F	DF	510	cmpr	a, Ch' f
ROM PAGE NO. 6				
0180	6168	511	b	key007
		512		
0182	3985	513	test	spuvs1,0
0184	616A	514	b	key008
		515		
0186	3945	516	clr	spuvs1,0
		517		
		518		
0188	3952	519	clr	spus1,1
		520		
018A	6173	521	b	key006
		522		
		523		
ROM PAGE NO. 8				
0200		524	org	h' 200
		525		
0200	3C2A	526	dataact: ld	a, keynn
0202	30	527	xch	a, h
		528		

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PAGE 6

LOC	OBJ	LINE	SOURCE STATEMENT
0203	10	529	mov h, a
0204	DF	530	cmpr a, 2h'f
0205	0E	531	testp zf
0206	AA	532	b data04
		533	;
0207	3C29	534	ld a, keynd
0209	5C	535	test a, 0
020A	9E	536	b data01
		537	;
020B	5D	538	test a, 1
020C	A2	539	b data02
		540	;
020D	5E	541	test a, 2
020E	A6	542	b data03
		543	;
020F	30	544	xch a, h
		545	;
0210	30	546	data05: xch a, h
0211	4F	547	ld a, 2h'f
0212	3FFD	548	st a, dcm
0214	3FFE	549	data06: st a, dch
0216	10	550	mov h, a
0217	3FFC	551	st a, dcl
		552	;
0219	33	553	ldl a, 0dc
021A	31	554	xch a, l
		555	;
021B	32	556	ldh a, 0dc+
021C	30	557	xch a, h
		558	;
021D	2A	559	data10: ret
		560	;
021E	30	561	data01: xch a, h
021F	3824	562	or a, 2h'4
0221	90	563	b data05
		564	;
0222	30	565	data02: xch a, h
0223	3828	566	or a, 2h'8
0225	90	567	b data05
		568	;
0226	30	569	data03: xch a, h
0227	382C	570	or a, 2h'c
0229	90	571	b data05
		572	;
022A	3C29	573	data04: ld a, keynd
022C	30	574	xch a, h
022D	4E	575	ld a, 2h'e
022E	3FFD	576	st a, dcm
0230	4F	577	ld a, 2h'f
0231	94	578	b data06
		579	;
0232		580	
0232		581	
		582	;

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PAGE 7

LOC	OBJ	LINE	SOURCE	STATEMENT
ROM PAGE NO. 9				
0250		583	org	h'250
		584		
0250	2920	585	keyab:	xch h1,keab1
		586		
0252	3C23	587	ld	a,spusk
		588		
0254	3912	589	set	spus1,1
	ression			key currently dep
		590		
0256	D5	591	cmpr	a,zh'5
0257	0E	592	testp	zf
0258	AC	593	b	keyab4
		594		
0259	3902	595	set	spus1,0
	ilable			new character ava
		596		
025B	390F	597	set	servrc,0
		598		service request
025D	08	599	inc	a
		600		
025E	3F23	601	st	a,spusk
		602		
0260	05	603	rolc	a
		604		
0261	383E	605	and	a,zh'a
		606		
0263	J1	607	xch	a,1
		608		
0264	C4	609	ld	h,zh'4
		610		
0265	3C20	611	ld	a,keab1
0267	8F	612	st	a,0h1
		613		
0268	10	614	inc	1
		615		
0269	3C21	616	ld	a,keab4
026B	8F	617	st	a,0h1
		618		
026C	2A	619	keyab4: ret	
		620		
ROM PAGE NO. 12				
0300		621	org	h'300
		622		
		623		keyt routine
		624		
0300	3FCB	625	keyt:	st a,keytb
		626		
0302	40	627	ld	a,zh'0
		628		
0303	08	629	keyt0:	inc a
0304	00	630	nop	
0305	00	631	nop	
0306	00	632	nop	

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PAGE 8

LOC	OBJ	LINE	SOURCE STATEMENT
0307	0E	633	testp zf
0308	8A	634	b keyt1
		635	;
0309	83	636	b keyt0
		637	;
030A	3CCB	638	keyt1: ld a, keytb
		639	;
030C	2A	640	ret
		641	;
		642	;
		643	;
		644	!!!
		645	!!!
		646	!!!
		647	!!!

ROM PAGE NO. 12

0315		648	org h'315
		649	;
		650	ledd
		651	;
0315	10	652	ledd: mov h, a
		653	;
0316	5F	654	test a, 3
0317	99	655	b ledd01
0318	A8	656	b ledd00
		657	;
		658	ascii code
		659	;
0319	3804	660	ledd01: add a, sh'4
031B	3FFD	661	st a, dcs
031D	4F	662	ld a, sh'f
031E	3FFE	663	st a, dch
0320	31	664	xch a, l
0321	3FFC	665	st a, dcl
		666	;
0323	33	667	ldl a, 0dc
0324	31	668	xch a, l
		669	;
0325	32	670	ldh a, 0dc+
0326	30	671	xch a, h
		672	;
0327	2A	673	ret
		674	;
		675	;
		676	for each segment
		677	;
0328	2920	678	ledd00: xch hl, keytbl
		679	;
032A	E0	680	ld l, 20
032B	C2	681	ld h, 22
		682	;
032C	4F	683	ld a, sh'f
032D	1F	684	xor a, 0h1

LOC	OBJ	LINE	SOURCE STATEMENT
		685	
032E	0F	686	st a,0h1
		687	
032F	18	688	inc l
0330	4F	689	ld a,2h'f
		690	
0331	1F	691	xor a,0h1
0332	0F	692	st a,0h1
		693	
0333	2920	694	xch hl,kastb1
		695	
0335	2A	696	ret
		697	
		698	
		699	
		700	!!!
		701	!!!
		702	!!!

ROM PAGE NO.13

0350		703	org h'350	
		704		
		705	flash routine	
		706		
0350	3C35	707	flash: ld a,ldatm1	
0352	3F39	708	st a,ldasm1	
0354	3C36	709	ld a,ldatm2	
0356	3F3A	710	st a,ldasm2	
0358	3C37	711	ld a,ldat11	
035A	3F3B	712	st a,ldasm1	
035C	3C38	713	ld a,ldat12	
035E	3F3C	714	st a,ldasm12	
		715		
0360	3C33	716	ld a,displw	
0362	5C	717	test a,0	
0363	A9	718	b flash0	; wad not flashing
		719		
		720	wad flashing	
		721		
0364	4F	722	ld a,2h'f	
0365	3F39	723	st a,ldasm1	
0367	3F3A	724	st a,ldasm2	
		725		
0369	3C33	726	flash0: ld a,displw	
036B	5D	727	test a,1	
036C	B2	728	b flash1	; lad not flashing
		729		
		730	lad flashing	
		731		
036D	4F	732	ld a,2h'f	
036E	3F3B	733	st a,ldasm1	
0370	3F3C	734	st a,ldasm12	
		735		
0372	3C34	736	flash1: ld a,displw	

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LOC	OBJ	LINE	SOURCE	STATEMENT	
0374	5D	737	test	a,1	
0375	63AC	738	b	flas30	; indicator 'off'
		739			
0377	5C	740	test	a,0	
0378	6393	741	b	flas20	; indicator 'on'
		742			
		743			
		744		indicator flashing	
		745			
037A	3C36	746	ld	a,ldatm2	
037C	3837	747	and	a,\$0111b	
037E	3F36	748	st	a,ldatm2	
		749			
ROM PAGE NO. 14					
0380	3C38	750	ld	a,ldat12	
0382	3837	751	and	a,\$0111b	
0384	3F38	752	st	a,ldat12	; indicator 'on' on
riod					
		753			
0386	3C3A	754	ld	a,ldasm2	
0388	3828	755	or	a,\$1000b	
038A	3F3A	756	st	a,ldasm2	
		757			
038C	3C3C	758	ld	a,ldas12	
038E	3828	759	or	a,\$1000b	
0390	3F3C	760	st	a,ldas12	; indicator 'off' o
eriod					
		761			
0392	2A	762	ret		
		763			
		764			
		765			
		766		indicator 'on'	
		767			
0393	3C36	768	flas20: ld	a,ldatm2	
0395	3837	769	and	a,\$0111b	
0397	3F36	770	st	a,ldatm2	
		771			
0399	3C38	772	ld	a,ldat12	
039B	3837	773	and	a,\$0111b	
039D	3F38	774	st	a,ldat12	
		775			
039F	3C3A	776	ld	a,ldasm2	
03A1	3837	777	and	a,\$0111b	
03A3	3F3A	778	st	a,ldasm2	
		779			
03A5	3C3C	780	ld	a,ldas12	
03A7	3837	781	and	a,\$0111b	
03A9	3F3C	782	st	a,ldas12	
		783			
03AB	2A	784	ret		
		785			
		786		indicator 'off'	
		787			
03AC	3C36	788	flas30: ld	a,ldatm2	

LOC	OBJ	LINE	SOURCE STATEMENT
03AE	3828	789	or a, \$1000b
03B9	3F36	790	st a, ldat12
		791	
03B2	3C38	792	ld a, ldat12
03B4	3828	793	or a, \$1000b
03B6	3F38	794	st a, ldat12
		795	
03B8	3C3A	796	ld a, ldam2
03BA	3828	797	or a, \$1000b
03BC	3F3A	798	st a, ldam2
		799	
03BE	3C3C	800	ld a, ldam12
ROM PAGE NO. 13			
03C9	3828	801	or a, \$1000b
03C2	3F3C	802	st a, ldam12
		803	
03C4	2A	804	ret
		805	
		806	end

ASSEMBLY COMPLETE.

0 PROGRAM ERROR(S)



## SYMBOL TABLE

* COMMAND	0013	* COMMAN	0015	* COMMAL	0014	DATA01	021E
DATA02	0222	DATA03	0226	DATA04	022A	DATA05	0210
DATA06	0214	* DATA0H	0001	* DATA0L	0000	* DATA10	021D
* DATA1H	0003	* DATA1L	0002	* DATA2H	0005	* DATA2L	0004
* DATA3H	0007	* DATA3L	0006	* DATA4H	0009	* DATA4L	0008
DATAC	0200	DCH	00FE	DCL	00FC	DCM	00FD
* DISPA	0032	* DISPH	0031	DISPIW	0034	* DISPL	0030
DISPLW	0033	FLASH0	0393	FLASH30	03AC	* FLASH	0350
FLASH0	0369	FLASH1	0372	* INCOTH	008C	* INCOTL	008A
* INCOTM	008B	* KEST	0022	KEST0H	0043	KEST0L	0042
* KEST1H	0045	* KEST1L	0044	* KEST2H	0047	* KEST2L	0046
* KEST3H	0049	* KEST3L	0048	* KEST4H	004B	* KEST4L	004A
* KEST5H	004D	* KEST5L	004C	KESTBH	0021	KESTBL	0020
KEY001	0107	KEY002	0118	KEY003	0132	KEY004	0136
KEY005	017D	KEY006	0173	KEY007	0160	KEY008	016A
KEY010	0172	KEY020	0142	KEY021	0151	KEY022	0178
* KEY030	015E	KEYND	0029	KEYNN	002A	KEYOD	002B
KEYON	002C	* KEYS	0100	KEYSB	0250	KEYSB4	026C
KEYSC	000E	KEYT	0300	KEYT0	0303	KEYT1	030A
KEYTB	00CB	* LCICOT	000D	LDASL1	003B	LDASL2	003C
LDASM1	0039	LDASM2	003A	LDATL1	0037	LDATL2	0038
LDATM1	0035	LDATM2	0036	* LDISP	0B00	* LECOTM	008F
* LECOTL	008D	* LECOTM	008E	* LEDD	0315	LEDD00	0328
LEDD01	0319	* LIOVF1	0600	* LIOVF2	0D00	* LMAIN	03E0
* LREM0	0E00	* LTABLE	0000	* LVLFEH	0C00	* OVER2A	0072
* OVER2H	0071	* OVER2L	0070	* OVERA1	0012	* OVERH1	0011
* OVERL1	0010	* PARITT	000C	* PARITY	000B	* READC	0028
* READN	0027	* REMD0	0060	* REMD1	0061	* REMD2	0062
* REMD3	0063	* REMD4	0064	* REMD5	0065	* REMD6	0066
* REMD7	0067	* REMD8	006A	* REMD9	0069	* REMOL	0068
* RKCE	0050	RKCE0	006C	RKCE1	0071	RKCE2	0070
* RKCE3	007F	RKCE4	006B	RKCE5	0058	* RNH	006B
* RNL	006D	* RNH	006C	* RWRPCH	00CA	* RWRPCL	00C8
* RWRPCM	00C9	SERVRC	000F	SPUCP	0024	SPUFF	0017
* SPUSH	0003	SPUSK	0023	SPUSL	0002	* SPUVDM	0004
SPUVSH	0000	SPUVSL	0005	* SPUVUM	0001	* SPV	00FF
* SPWB	00C7	* TIMR2H	00FA	* TIMR2L	00F8	* TIMR2M	00F9
* TIMRH	00F6	* TIMRH0	001B	* TIMRLN	00F4	* TIMRLD	0019
* TIMRMN	00F5	* TIMRMD	001A	* VLFC	000A	* VLFEC	0016
* VLFRB	0009	* VLFTB	0008	* VLFTH	0007	* VLFTL	0006
* VLFXA	0052	* VLFXH	0051	* VLFXL	0050	* WARPCL	00C4
* WARPCH	00C5	* WRITEH	0026	* WRITEN	0025		

DEFINED 167 USER SYMBOL(S)

LOC	OBJ	LINE	SOURCE STATEMENT
		1	data table
		2	
		3	
		4	
		5	
		6	command coding table
		7	
		8	

ROM PAGE NO. 60

0F20	9	org	h'720	
0F20 01	11	data	h'01	; '00' read status
0F21 10	12	data	h'10	; '01' indicator power cont
rol 0F22 10	13	data	h'10	; '02' indicator mode
0F23 10	14	data	h'10	; '03' device input control
0F24 10	15	data	h'10	; '04' device output contro
1 0F25 10	16	data	h'10	; '05' power relay control
0F26 00	17	data	h'00	; '06' clear display
0F27 10	18	data	h'10	; '07' device display contr
ol 0F28 10	19	data	h'10	; '08' insert character
0F29 02	21	data	h'02	; '09' read device data
0F2A 20	22	data	h'20	; '0a' display character at
specified position 0F2B 0F	23	data	h'0F	; '0b' conditional poll
0F2C 00	24	data	h'00	; blank
0F2D 00	25	data	h'00	; blank
0F2E 00	26	data	h'00	; blank
0F2F 00	27	data	h'00	; blank
	28			
0F30 00	29	data	h'00	; blank
0F31 00	30	data	h'00	; blank
0F32 00	31	data	h'00	; blank
0F33 00	32	data	h'00	; blank
0F34 00	33	data	h'00	; blank
0F35 00	34	data	h'00	; blank
0F36 00	35	data	h'00	; blank
0F37 00	36	data	h'00	; blank
	37			
0F38 00	38	data	h'00	; blank
0F39 00	39	data	h'00	; blank
0F3A 00	40	data	h'00	; blank
0F3B 00	41	data	h'00	; blank
0F3C 00	42	data	h'00	; blank
0F3D 00	43	data	h'00	; blank
0F3E 00	44	data	h'00	; blank
0F3F 20	45	data	h'20	; command expansion
	46			
	47			
	48	ascii coding		
	49			

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PAGE 2

LOC	OBJ	LINE	SOURCE STATEMENT
0F40		50	org h'f40
		51	
		52	f40-f4f
		53	
		54	
		55	f40-f6f -> h'ff 'blank'
		56	
0F40	FF	57	data h'ff
0F41	FF	58	data h'ff
0F42	FF	59	data h'ff
0F43	FF	60	data h'ff
0F44	FF	61	data h'ff
0F45	FF	62	data h'ff
0F46	FF	63	data h'ff
0F47	FF	64	data h'ff
		65	
0F48	FF	66	data h'ff
0F49	FF	67	data h'ff
0F4A	FF	68	data h'ff
0F4B	FF	69	data h'ff
0F4C	FF	70	data h'ff
0F4D	FF	71	data h'ff
0F4E	FF	72	data h'ff
0F4F	FF	73	data h'ff
		74	
		75	f50-f5f
		76	
0F50	FF	77	data h'ff
0F51	FF	78	data h'ff
0F52	FF	79	data h'ff
0F53	FF	80	data h'ff
0F54	FF	81	data h'ff
0F55	FF	82	data h'ff
0F56	FF	83	data h'ff
0F57	FF	84	data h'ff
		85	
0F58	FF	86	data h'ff
0F59	FF	87	data h'ff
0F5A	FF	88	data h'ff
0F5B	FF	89	data h'ff
0F5C	FF	90	data h'ff
0F5D	FF	91	data h'ff
0F5E	FF	92	data h'ff
0F5F	FF	93	data h'ff
		94	
		95	f60-f6f
		96	
0F60	FF	97	data h'ff
0F61	FF	98	data h'ff
0F62	FF	99	data h'ff
0F63	FF	100	data h'ff
0F64	FF	101	data h'ff
0F65	FF	102	data h'ff
0F66	FF	103	data h'ff

LOC	OBJ	LINE	SOURCE	STATEMENT
0F67	FF	104	data	h'ff
		105		
0F68	FF	106	data	h'ff
0F69	FF	107	data	h'ff
0F6A	FF	108	data	h'ff
0F6B	FF	109	data	h'ff
0F6C	FF	110	data	h'ff
0F6D	FF	111	data	h'ff
0F6E	FF	112	data	h'ff
0F6F	FF	113	data	h'ff
		114		
		115		179-17f
		116		
0F70	C0	117	data	h'c0 ; 0
0F71	F9	118	data	h'f9 ; 1
0F72	A4	119	data	h'a4 ; 2
0F73	B0	120	data	h'b0 ; 3
0F74	99	121	data	h'99 ; 4
0F75	92	122	data	h'92 ; 5
0F76	82	123	data	h'82 ; 6
0F77	D8	124	data	h'd8 ; 7
		125		
0F78	80	126	data	h'80 ; 8
0F79	90	127	data	h'90 ; 9
0F7A	FF	128	data	h'ff ; blank
0F7B	C9	129	data	h'c9 ; 11
0F7C	FF	130	data	h'ff ; blank
0F7D	B7	131	data	h'b7 ; =
0F7E	FF	132	data	h'ff ; blank
0F7F	FF	133	data	h'ff ; blank
		134		
		135		180-18f
		136		
ROM PAGE NO. 62				
0F80	FF	137	data	h'ff ; blank
0F81	00	138	data	h'00 ; A
0F82	03	139	data	h'03 ; b
0F83	C6	140	data	h'c6 ; C
0F84	A1	141	data	h'a1 ; d
0F85	06	142	data	h'06 ; E
0F86	0E	143	data	h'0e ; F
0F87	02	144	data	h'02 ; 0
		145		
0F88	09	146	data	h'09 ; H
0F89	CF	147	data	h'cf ; I
0F8A	E1	148	data	h'e1 ; J
0F8B	FF	149	data	h'ff ; blank
0F8C	C7	150	data	h'c7 ; L
0F8D	FF	151	data	h'ff ; blank
0F8E	FF	152	data	h'ff ; blank
0F8F	C0	153	data	h'c0 ; 0
		154		
		155		190-19f

LDC	OBJ	LINE	SOURCE STATEMENT
		156 ;	
0F90	8C	157	data h'8c ; P
0F91	FF	158	data h'ff ; blank
0F92	AF	159	data h'af ; r
0F93	92	160	data h'92 ; S
0F94	FF	161	data h'ff ; blank
0F95	C1	162	data h'c1 ; U
0F96	FF	163	data h'ff ; blank
0F97	FF	164	data h'ff ; blank
		165 ;	
0F98	FF	166	data h'ff ; blank
0F99	FF	167	data h'ff ; blank
0F9A	FF	168	data h'ff ; blank
0F9B	FF	169	data h'ff ; blank
0F9C	FF	170	data h'ff ; blank
0F9D	FF	171	data h'ff ; blank
0F9E	FF	172	data h'ff ; blank
0F9F	BF	173	data h'bf ; blank
		174 ;	
		175 ;	fa0-faf
		176 ;	
0FA0	FF	177	data h'ff ; blank
0FA1	88	178	data h'88 ; A
0FA2	83	179	data h'83 ; b
0FA3	C6	180	data h'c6 ; C
0FA4	A1	181	data h'a1 ; d
0FA5	86	182	data h'86 ; E
0FA6	8E	183	data h'8e ; F
0FA7	82	184	data h'82 ; G
		185 ;	
0FA8	89	186	data h'89 ; H
0FA9	CF	187	data h'cf ; I
0FAA	E1	188	data h'e1 ; J
0FAB	FF	189	data h'ff ; blank
0FAC	C7	190	data h'c7 ; L
0FAD	FF	191	data h'ff ; blank
0FAE	FF	192	data h'ff ; blank
0FAF	C0	193	data h'c0 ; O
		194 ;	
		195 ;	fb0-fbf
		196 ;	
0FB0	8C	197	data h'8c ; P
0FB1	FF	198	data h'ff ; blank
0FB2	AF	199	data h'af ; r
0FB3	92	200	data h'92 ; S
0FB4	FF	201	data h'ff ; blank
0FB5	C1	202	data h'c1 ; blank
0FB6	FF	203	data h'ff ; blank
0FB7	FF	204	data h'ff ; blank
		205 ;	
0FB8	FF	206	data h'ff ; blank
0FB9	FF	207	data h'ff ; blank
0FBA	FF	208	data h'ff ; blank
0FBB	FF	209	data h'ff ; blank
0FBC	FF	210	data h'ff ; blank

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LOC	OBJ	LINE	SOURCE STATEMENT
0FBD	FF	211	data h'ff ; blank
0FBE	FF	212	data h'ff ; blank
0FBF	FF	213	data h'ff ; blank
		214	;
		215	;
		216	remote control data
		217	;

ROM PAGE NO. 63

0FC8		218	org	h'fc8	
		219			
0FC8	FF	220	data	h'ff	
0FC1	FF	221	data	h'ff	
0FC2	FF	222	data	h'ff	
0FC3	FF	223	data	h'ff	
0FC4	13	224	data	h'13	; on / off
0FC5	11	225	data	h'11	; event
0FC6	FF	226	data	h'ff	
0FC7	16	227	data	h'16	; clear
0FC8	FF	228	data	h'ff	
0FC9	FF	229	data	h'ff	
0FCA	FF	230	data	h'ff	
0FCB	FF	231	data	h'ff	
0FCC	FF	232	data	h'ff	
0FCD	12	233	data	h'12	; auth
0FCE	FF	234	data	h'ff	
0FCF	17	235	data	h'17	; send
		236			
0FD0	FF	237	data	h'ff	
0FD1	38	238	data	h'38	; 8
0FD2	34	239	data	h'34	; 4
0FD3	18	240	data	h'18	; +
0FD4	32	241	data	h'32	; 2
0FD5	14	242	data	h'14	; -
0FD6	36	243	data	h'36	; 6
0FD7	FF	244	data	h'ff	
0FD8	31	245	data	h'31	; 1
0FD9	39	246	data	h'39	; 9
0FDA	35	247	data	h'35	; 5
0FDB	FF	248	data	h'ff	
0FDC	33	249	data	h'33	; 3
0FDD	38	250	data	h'38	; 8
0FDE	37	251	data	h'37	; 7
0FDF	15	252	data	h'15	; scan
		253			
		254			

ROM PAGE NO. 63

0FE7		255	org	h'fe7	
		256			
		257	keyscan data		
		258			
0FE7	37	259	data	h'37	; '7'

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LOC	OBJ	LINE	SOURCE STATEMENT
0FE8	00	260	data h'00
0FE9	00	261	data h'00
0FEA	00	262	data h'00
0FEB	32	263	data h'32
0FEC	00	264	data h'00
0FED	34	265	data h'34
0FEE	13	266	data h'13
0FEF	00	267	data h'00
0FF0	14	268	data h'14
0FF1	15	269	data h'15
0FF2	16	270	data h'16
0FF3	36	271	data h'36
0FF4	17	272	data h'17
0FF5	00	273	data h'00
0FF6	00	274	data h'00
0FF7	12	275	data h'12
0FF8	10	276	data h'10
0FF9	11	277	data h'11
0FFA	35	278	data h'35
0FFB	33	279	data h'33
0FFC	30	280	data h'30
0FFD	39	281	data h'39
0FFE	38	282	data h'38
0FFF	31	283	data h'31
		284	
		285	
		286	end

ASSEMBLY COMPLETE,

0 PROGRAM ERROR(S)

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SYMBOL TABLE

DEFINED      @ USER SYMBOL(S)



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CP/M TLCS-47 ASSEMBLER V2.2

PAGE 1

LDC OBJ LINE SOURCE STATEMENT

```

1 |-----|
2 |                                     7.1983. |
3 |      ldisp.asm      V1.0 |
4 |                                     (TMP4748D) |
5 |                                     |
6 |      display      routine |
7 |                                     |
8 |-----|
9 |

```

enolist

slist

```

302 |
303 |

```

ROM PAGE NO.44

```

0B00      304      org      h'b00
305 |
306 | interrupts enable
307 |
0B00 3F32      308      st      a,dispa
0B02 44      309      ld      a,20100b
0B03 13      310      xch      a,eir
0B04 366F      311      eiClr  11,101111b
312 |
313 |
314 |
315 | push register
316 |
317 |
0B06 2930      318      xch      hl,displ
319 |
320 | count up led counter
321 |
0B08 3C8D      322      ld      a,lecot1
0B0A 08      323      inc      a
0B0B 3F8D      324      st      a,lecot1
325 |
0B0D D0      326      cmpr     a,2h'0
0B0E B3      327      b        displ0
328 |
0B0F 3C8E      329      ld      a,lecotm
0B11 08      330      inc      a
0B12 3F8E      331      st      a,lecotm
332 |
0B14 D0      333      cmpr     a,2h'0
0B15 B3      334      b        displ0
335 |

```

LOC	OBJ	LINE	SOURCE STATEMENT
0B16	3C8F	336	ld a, lecoth
0B18	08	337	inc a
0B19	3F8F	338	st a, lecoth
		339	;
0B1B	D8	340	cmpr a, 2h'0
0B1C	B3	341	b displ0
		342	;
		343	;
		344	counter over flow
		345	;
		346	;
0B1D	4F	347	ld a, 2h'f
0B1E	3F8F	348	st a, lecoth
0B20	43	349	ld a, 2h'3
0B21	3F8E	350	st a, lecoth
0B23	48	351	ld a, 2h'0
0B24	3F8D	352	st a, lecot1
		353	;
0B26	3C33	354	ld a, displw ; invert flag
0B28		355	;
0B28	5E	356	test a, 2
0B29	AF	357	b displ2
		358	;
0B2A	3839	359	and a, 2011b
		360	;
0B2C	3F33	361	st a, displw ; '1'-'0'
0B2E	B3	362	b displ0
		363	;
0B2F	3824	364	displ2: or a, 20100b ; '0'-'1'
0B31	3F33	365	st a, displw
		366	;
		367	;
		368	led "on"
		369	;
		370	;
0B33	3C33	371	displ0: ld a, displw
0B35	5E	372	test a, 2
0B36	6B63	373	b displ1 ; imaginely part
		374	;
		375	;
		376	real part
		377	;
		378	;
		379	;
		380	led 'on'
		381	;
0B38	5F	382	test a, 3
0B39	6B4F	383	b displ3 ; led 'on'
		384	;
		385	and 'on'
		386	;
0B3B	3837	387	and a, 20111b
0B3D	3F33	388	st a, displw
0B3F	3C35	389	ld a, ldatm1

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PAGE 3

LOC	OBJ	LINE	SOURCE STATEMENT
ROM PAGE NO. 45 *			
0B41	3AA1	390	out a,%op01
0B43	3C36	391	ld a,ldata2
0B45	3AA2	392	out a,%op02
0B47	3B56	393	clr %op05,1
0B49	3B26	394	set %op05,2
		395	
0B4B	3925	396	set spuvs1,2 ; 'keyscan ready' o
		397	
0B4D	6B89	398	b displ0
		399	
		400	ld 'on'
		401	
0B4F	3B2B	402	displ3: or a,%1000b
0B51	3F33	403	st a,displw
		404	
0B53	3C37	405	ld a,ldat11
0B55	3AA1	406	out a,%op01
0B57	3C38	407	ld a,ldat12
0B59	3AA2	408	out a,%op02
0B5B	3B16	409	set %op05,1
0B5D	3B66	410	clr %op05,2
		411	
0B5F	6B89	412	b displ0
		413	
		414	
		415	imaginary part
		416	
		417	
		418	key scan ready
		419	
0B61	3925	420	set spuvs1,2
		421	
0B63	5F	422	displ1: test a,3
0B64	89	423	b displ4
		424	
		425	msd 'on'
		426	
0B65	3B37	427	and a,%0111b
0B67	3F33	428	st a,displw
		429	
0B69	3C39	430	ld a,ldasm1
0B6B	3AA1	431	out a,%op01
0B6D	3C3A	432	ld a,ldasm2
0B6F	3AA2	433	out a,%op02
		434	
0B71	3B26	435	set %op05,2
0B73	3B56	436	clr %op05,1
		437	
0B75	3925	438	set spuvs1,2 ; key scan ready
		439	
0B77	6B89	440	b displ0
		441	
		442	ld 'on'

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PAGE 4

LOC	OBJ	LINE	SOURCE STATEMENT
		443 ;	
0879	3828	444	displ4: or a,21000b
0878	3F33	445	st a,displw
		446 ;	
0870	3C3B	447	ld a,ldas11
087F	3AA1	448	out a,xop01
ROM PAGE NO.46 *			
0881	3C3C	449	ld a,ldas12
0883	3AA2	450	out a,xop02
		451 ;	
0885	3B16	452	set xop06,1
0887	3B66	453	clr xop06,2
		454 ;	
		455 ;	
		456 ;	return
		457 ;	
		458 ;	
0889	2938	459	displ0: xch hl,displ
		460 ;	
088B	47	461	ld a,2h'7
		462 ;	
088C	3EAF	463	dclr il,101111b
		464 ;	
088E	3C1C	465	ld a,eirb
0890	13	466	xch a,eir
0891	3C32	467	ld a,dispa
		468 ;	
0893	2D	469	reti
		470 ;	
		471	end

ASSEMBLY COMPLETE,

0 PROGRAM ERROR(S)

## SYMBOL TABLE

* COMMA0	0013	* COMMAH	0015	* COMMAL	0014	* DATA0H	0081
* DATA0L	0080	* DATA1H	0083	* DATA1L	0082	* DATA2H	0085
* DATA2L	0084	* DATA3H	0087	* DATA3L	0086	* DATA4H	0089
* DATA4L	0088	* DATACT	0200	* DCH	00FE	* DCL	00FC
* DCH	00FD	* DISPA	0032	* DISPH	0031	* DISPI0	0089
* DISPIW	0034	* DISPL	0030	* DISPL0	0033	* DISPL1	0063
* DISPL2	002F	* DISPL3	004F	* DISPL4	0079	* DISPLW	0033
* EIRB	001C	* FLASH	0330	* INCOTM	008C	* INCOTL	008A
* INCOTM	008B	* KEST	0022	* KEST0H	0043	* KEST0L	0042
* KEST1H	0045	* KEST1L	0044	* KEST2H	0047	* KEST2L	0046
* KEST3H	0049	* KEST3L	0048	* KEST4H	004B	* KEST4L	004A
* KEST5H	004D	* KEST5L	004C	* KESTBH	0021	* KESTBL	0020
* KEYND	0029	* KEYNN	002A	* KEYOD	002B	* KEYON	002C
* KEYS	0100	* KEYSB	0250	* KEYSO	000E	* KEYT	0300
* KEYTB	00CB	* LCICOT	000D	* LDASL1	003B	* LDASL2	003C
* LDASM1	0039	* LDASM2	003A	* LDATL1	0037	* LDATL2	0038
* LDATM1	0035	* LDATM2	0036	* LECOTH	008F	* LECOTL	008D
* LECOTM	008E	* LEDD	0310	* LIOVF1	0600	* LIOVF2	0D00
* LMAIN	03E0	* LREM0	0E00	* LVLFEH	0C00	* OVER2A	0072
* OVER2H	0071	* OVER2L	0070	* OVERA1	0012	* OVERH1	0011
* OVERL1	0010	* PARITT	000C	* PARITY	000B	* READC	0028
* READN	0027	* REMD0	0050	* REMD1	0061	* REMD2	0062
* REMD3	0063	* REMD4	0064	* REMD5	0065	* REMD6	0066
* REMD7	0067	* REMOA	006A	* REMOH	0069	* REMOL	0068
* RKCE	0050	* RNH	006B	* RNL	006D	* RNW	006C
* RWRPCH	00CA	* RWRPCL	00CB	* RWRPCM	00C9	* SERVRC	000F
* SPUCP	0024	* SPUSH	0003	* SPUSK	0023	* SPUSL	0002
* SPUVDM	0004	* SPUVSH	0000	* SPUVSL	0003	* SPUVUM	0001
* SPW	00FF	* SPWB	00C7	* TABLE	0000	* TIMR2H	00FA
* TIMR2L	00F8	* TIMR2M	00F9	* TIMRHN	00F6	* TIMRHO	001B
* TIMRLN	00F4	* TIMRLD	0019	* TIMRMN	00F5	* TIMRMO	001A
* VLFC	000A	* VLFEH	0016	* VLFRB	0009	* VLFTB	0008
* VLFTH	0007	* VLFTL	0006	* VLFXA	0052	* VLFXH	0051
* VLFXL	0050	* WARPCL	00C4	* WARPCH	00C5	* WRITEN	0026
* WRITEN	0025						

DEFINED 137 USER SYMBOL(S)

LOC	OBJ	LINE	SOURCE STATEMENT
		1	-----
		2	7.1983.
		3	ltable.asm V1.0
		4	(TMP4748P)
		5	
		6	table routine
		7	
		8	
		9	-----
			enolist
			elist
		27	
			ROM PAGE NO. 0
0000		28	org h'000
0000 63E0		29	b lmain
		30	
0002 6C00		31	b lvlfex
		32	
0004 29		33	reti
0005 00		34	nop
		35	
0006 6600		36	b liovf1
		37	
0008 6D00		38	b liovf2
		39	
000A 6B00		40	b ldisp
		41	
000C 6E00		42	b lromo
		43	
		44	end

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SYMBOL TABLE

LDISP	0B00	LIOVF1	0600	LIOVF2	0D00	LMAIN	03E0
LRMO	0E00	LVLFEY	0C00				

DEFINED 6 USER SYMBOL(S)

LOC	OBJ	LINE	SOURCE STATEMENT
		1	;
		2	;
		3	liovf2.asm V1.0 7.1983.
		4	(TMP4740P)
		5	;
		6	remote con. routine
		7	;
		8	;
		9	;
			enolist
			elist
		268	;
			ROM PAGE NO. 52
0000		269	org h'000
		270	;
		271	;
		272	;
		273	push register
		274	;
		275	;
0000 3F72		276	st a,over2a
0002 44		277	ld a,20100b
0003 13		278	xch a,eir
0004 366F		279	exchrl 11,101111b
0006 2970		280	xch hl,over21
		281	;;
		282	;; timer2 stop
		283	;;
0008 40		284	ld a,20
0009 3A8D		285	out a,xopl0
		286	;;;;;;;;;;;;;
		287	;;;;;;;;;;;;;
		288	;
		289	;; check N1 routine
		290	;
000B 3C6B		291	ld a,rnh
000D D1		292	cmpr a,21
000E 6D43		293	b rem100 ; N1 was not '1'
		294	;;
		295	;; N1=1
		296	;;
0D10 3BD0		297	testp x00,1 ; check port for remote
0D12 AF		298	b rem200 ; port was '1', it was not
start bit			
		299	;
		300	;; it was start bit
		301	;



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PAGE 2

LOC	OBJ	LINE	SOURCE STATEMENT
0D13	42	302	ld a,22
0D14	3F6B	303	st a,rnh ; N2-2
		304	;
		305	setting timer2
0D16	3B06	306	set %op06,0
0D18	4F	307	ld a,2h'f
0D19	3FFA	308	st a,timr2h
0D1B	4D	309	ld a,2h'd
0D1C	3FF9	310	st a,timr2m
0D1E	47	311	ld a,27
0D1F	3FF8	312	st a,timr2l
		313	;;
0D21	48	314	ld a,28
0D22	3A8D	315	out a,%op1d ; timer2 start
		316	;;
		317	return routine
		318	;;
0D24	2970	319	rem300: xch hl,over2l
0D26	47	320	ld a,20111b
0D27	36AF	321	dclr il,101111b
0D29	13	322	xch a,eir
0D2A	3C72	323	ld a,over2a
		324	;;
0D2C	3B46	325	clr %op06,0
0D2E	2B	326	reti
		327	;
		328	;;
0D2F	39F0	329	rem200: testp spuvsh,3
0D31	B3	330	b rem210
		331	;
0D32	A4	332	b rem300 ; jump to return routine
		333	;
		334	;
0D33	3B06	335	rem210: set %op06,0
0D35	4F	336	ld a,2h'f
0D36	3FFA	337	st a,timr2h
0D38	45	338	ld a,25
0D39	3FF9	339	st a,timr2m
0D3B	4E	340	ld a,2h'e
0D3C	3FF8	341	st a,timr2l
		342	;;
0D3E	48	343	ld a,28
0D3F	3A8D	344	out a,%op1d
		345	;;

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0D41	6D24	346	b rem300
		347	;;;;;;;;;;;;;
		348	;;;;;;;;;;;;;
		349	;;;;;;;;;;;;;
		350	;
		351	;
		352	N1 was not '1'
		353	;

LOC	OBJ	LINE	SOURCE STATEMENT
0D43	3C6B	354	rem100: ld a,rnh
0D45	00	355	cmpr a,20
0D46	0E	356	testp zf
0D47	92	357	b rem110
0D48	8B	358	rem100: b rem100
		359	;;
		360	;
0D49	40	361	rem120: ld a,20
0D4A	3F6B	362	st a,rnh
0D4C	3F6C	363	st a,rnd
0D4E	3F6D	364	st a,rnl
		365	;
0D50	6D24	366	b rem300
		367	!!!
		368	!!!
		369	!!!
0D52	39B0	370	rem110: test spuvsh,3
0D54	89	371	b rem120 ; F1 was not '1'
		372	;
		373	;
		374	;
		375	clr spuvsh,3
		376	;
0D57	3952	377	clr spusl,1 ; (key currently depressed
			) off
		378	;
0D59	6D24	379	b rem300 ; return
		380	;
		381	end

ASSEMBLY COMPLETE, 0 PROGRAM ERROR(S)

0167237

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CP/M TLC8-47 ASSEMBLER V2.2

PAGE 4

## SYMBOL TABLE

* COMMD	0013	* COMMFC	0015	* COMMBR	0014	* DATACT	0200
* DCH	00FE	* DCL	00FC	* DCM	00FD	* DISPA	0032
* DISPH	0031	* DISPIW	0034	* DISPL	0030	* DISPLW	0033
* INCOTH	0038	* INCOTL	0039	* INCOTM	003A	* KEST	0043
* KEST0H	0023	* KEST0L	0022	* KEST1H	0025	* KEST1L	0024
* KEST2H	0027	* KEST2L	0026	* KEST3H	0029	* KEST3L	0028
* KEST4H	0029	* KEST4L	002A	* KESTBH	0041	* KESTBL	0040
* KEYND	002C	* KEYNN	002D	* KEYOD	002E	* KEYON	002F
* KEYS	0100	* KEYSB	0250	* KEYBC	000E	* KEYTB	00C9
* LCICOT	000D	* LDATL1	0037	* LDATL2	0038	* LDATM1	0035
* LDATM2	0036	* LDISP	0000	* LECOTH	003E	* LECOTL	003C
* LECOTH	003D	* LIOVF1	0600	* LMAIN	03E0	* LREM0	0E00
* LVLFEH	0C00	* OVER2A	0072	* OVER2H	0071	* OVER2L	0070
* OVERA1	0012	* OVERH1	0011	* OVERL1	0010	* PARITT	000C
* PARITY	000B	* RE1000	0D48	* REM100	0D43	* REM110	0D52
* REM120	0D49	* REM200	0D2F	* REM210	0D33	* REM300	0D24
* REMD0	0060	* REMD1	0061	* REMD2	0062	* REMD3	0063
* REMD4	0064	* REMD5	0065	* REMD6	0066	* REMD7	0067
* REMDA	006A	* REMOH	0069	* REMOL	0068	* RKCE	0050
* RNH	006B	* RNL	006D	* RNH	006C	* RWRPCH	00CA
* RWRPCL	00C8	* RWRPCM	00C9	* SERVRC	000F	* SPUCP	0021
* SPUSH	0003	* SPUSK	0020	* SPUGL	0002	* SPUVDM	0004
* SPUVSH	0000	* SPUVSL	0005	* SPUVLM	0001	* SPW	00FF
* SPWB	00C7	* TABLE	0000	* TIMR2H	00FA	* TIMR2L	00FB
* TIMR2H	00F9	* TIMRHN	00F6	* TIMRHO	001B	* TIMRLN	00F4
* TIMRLO	0019	* TIMRMN	00F5	* TIMRMO	001A	* VDATAH	0018
* VDATAH	0017	* VLFC	000A	* VLFEH	0016	* VLFRB	0009
* VLFTB	0008	* VLFTH	0007	* VLFTL	0006	* VLFXA	0052
* VLFXH	0051	* VLFXL	0050	* WARPCL	00C4	* WARPCH	00C5

DEFINED 116 USER SYMBOL(S)

LOCATION	OBJECT CODE	LINE	SOURCE LINE
----------	-------------	------	-------------

```

1  '8041'
2  ;*****
3  ;*
4  ;*      3042      Drop Processor Main Routine      *
5  ;*
6  ;*****
7  ;      <<<<<<<<<<      Using Register      >>>>>>>>>>>>
8  ;
9  ;R0 ----- General Register      --Converter
10 ;R1 ----- General Register      --Used in drop poll map
11 ;R2 ----- General Register      --Converter
12 ;R3 ----- General Register      --Converter , Soft counter
13 ;R4 ----- General Register      RF cable switch ( Store cable num. )
14 ;R5 ----- Counter      for count 04 CHD
15 ;R6 -----
16 ;R7 ----- Interrupt routine start address
17 ;-----
18 ;      <<<<<<<<<<      Port      >>>>>>>>>>>>
19 ;P1 <5> <4> <3> <2> <1> <0>      Subscriber Select
20 ;P1 <7>      Test switch / Reset out ( 15 us. 10 us
21 ;P4 <3> <2> <1> <0>      Converter Control
22 ;P5 <3> <2> <1>      Drop Scan Switch      S2,S1,S0
23 ;P5 <4>      VLF OUT
24 ;P6 <3> <2> <1> <0>      Power Detect I
25 ;P7 <1> <0>      II
26 ;P7 <3> <2>      ECU Address
27 ;
28 ;
29 ;-----
30 ;CODE      Address      Comment      pin out
<0009> 30 DAT_1 EQU 00001001B ; Tuning data '1' 0 1
<0001> 31 DAT_0 EQU 00000001B ; Tuning data '0' 0 1
<0008> 32 CLKDAT EQU 00001000B ; Clock data '1' 0 0
<000A> 33 LODDAT EQU 00001010B ; Load pulse data '1' 0 2
<0004> 34 PWRD0T EQU 00000100B ; Power off 0 4
<000C> 35 PWRD1T EQU 00001100B ; Power on 0 4
<0003> 36 CABL_A EQU 00000011B ; Cable Select A 0 3
<000B> 37 CABL_B EQU 00001011B ; Cable Select B 0 3
<000D> 38 DETDAT EQU 00001101B ; Power check 0 3
<000E> 39 CABL_C EQU 00000110B ; Cable Select C 0 6
<000E> 40 CABL_D EQU 00001110B ; Cable Select D 0 6
41 ;
42 ;----- Variable constant -----
<0003> 43 COUNT_P5 EQU 3 ; 04-S4 Priority label
44 ;----- Sub. Command constant -----
45 ;DEVCNT EQU 00H ; Device control
46 ;DSPCNT EQU 01H ; Device display control
47 ;SETDWT EQU 02H ; Set data to device
48 ;REDDWT EQU 03H ; Read data
49 ;----- Memory loc. -----
50 ;Label      head address      Comment
<0020> 51 PWRDET EQU 20H ; 01 Command
<0021> 52 CHANNEL EQU 21H ; 03 Command
<0024> 53 SUBMES EQU 24H ; 04 Command SUB
<0025> 54 SMDHES EQU 25H ; 04 Command
<002D> 55 SUBPHR EQU 2DH ; 05 Command
<002F> 56 SUBSMT EQU 2FH ; 06 Command
<0031> 57 DRPPOL EQU 31H ; 07 Command

```

## APPENDIX B

FILE: DROP7\_RST:UEHAPA HEWLETT-PACKARD: 8041 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

<0038> 58 DEVPOL EQU 38H : 08 Command
<0056> 59 FOP84 EQU 56H : 84 Command
60 ; -----
61 ORG 0H
0000 15 62 DIS I : Disable ext interrupt
0001 0409 63 JMP START : Start Address
64 ORG 3H
0003 93 65 RETP :
66 ; ORG 7H
67 ; JMP TIMINT : TIMER INT.
68 ; -----
69 ORG 09H
0009 70 START:
71 ;
0009 237F 72 MOV A,#07FH :
000B 39 73 OUTL P1,A : RESET PULSE FOR PERIPHERAL PROCESSOR
000C 23FF 74 MOV A,#0FFH :
000E 39 75 OUTL P1,A :
76 ;
000F F5 77 EN FLAGS : enable flags IBF OBF
0010 A5 78 CLR F1 : F1 -- use for command header (A0)
0011 35 79 STARTU: DIS TCNT1 :
0012 65 80 STOP TCNT :
81 ; ===== Initialize =====
82 ; 04 command buffer clear
0013 B826 83 MOV R0,#SNDMES+1 :
0015 B040 84 MOV R0,#040H :
85 ;
86 ; 84 command buffer clear
0017 B857 87 MOV R0,#F0R84+1 :
0019 B0FF 88 MOV R0,#0FFH :
89 ;
001B B81C 90 MOV P0,#01CH : register bank 1 R4
001D B031 91 MOV R0,#DRPPOL : Set Drop poll map head address
92 ; for interrupt initial start.
001F B831 93 MOV R0,#DPPPOL :
0021 B807 94 MOV R3,#7 :
0023 B0FF 95 INILF1: MOV R0,#0FFH : Drop Poll Map initialization.
0025 18 96 INC P0 :
0026 EB23 97 DJNZ R3,INILF1 :
98 ;
0028 B836 99 MOV P0,#DEVPOL :
002A BA06 100 MOV P2,#4 :
002C B805 101 INILP2: MOV R3,#5 : Device Poll Map initialization.
002E B0FF 102 INILP3: MOV R0,#0FFH :
0030 18 103 INC R0 :
0031 EB2E 104 DJNZ R3,INILP3 :
0033 EA2C 105 DJNZ R2,INILP2 :
106 ;
0035 BF04 107 MOV R7,#04H : Initialize address Register.
108 ; for interrupt routine starting
109 ;
0037 2304 110 MOV A,#PWRDTC : All converter switch off
0039 14D2 111 CALL ALLCNT :
003B 2303 112 MOV A,#CABL_H :
003D 14D2 113 CALL ALLCNT :
114 ; MOV A,#CABL_C : Clear Subscriber data

```

FILE: UP007\_P51-UPH-PA MEMLOCIT-FINLIMPO: 8041 M77-1014

LOCATION OBJECT CODE LINE SOURCE LINE

```

115 : CALL ALLCHT :
116 :
117 : CALL INIT_P : Power detect line initialization
003F 5454 118 :
0041 C5 119 SEL R80 :
0042 230A 120 MOV A,8010 :
0044 62 121 MOV T,A : Timer counter set 010h
0045 8D03 122 MOV R5,8COUNT_R5 :
123 :
0047 25 124 EN TCNT1 :
0048 45 125 STRT CNT : *** initialize end *****
126 :-----
127 :
0049 D676 128 START2: JNBF CONT1 : IBF full ?
004B 7650 129 JF1 START3 : Case of using command port
130 :
004D 22 131 START4: IN A,DBB :
004E 0449 132 JMP START2 : Error -- Data Coming ignored
133 :
0050 45 134 START3: CLR F1 : F1 flag clear
0051 22 135 IN A,DBB : Input Command
0052 AE 136 MOV R3,A :
0053 03F7 137 ADD A,8-9 : If enter command is invalid one GT.2 then ignore
0055 F649 138 JC START2 : ( input ) *****
0057 FB 139 MOV A,R3 :
0058 035B 140 ADD A,8COMMAND :
005A B3 141 JMP 0A : Estimate jump address
142 :-----
005B 64 143 COMMAND: DB COM0 :
005C 66 144 DB COM1 :
005D 68 145 DB COM2 :
005E 6A 146 DB COM3 :
005F 6C 147 DB COM4 :
0060 6E 148 DB COM5 :
0061 70 149 DB COM6 :
0062 72 150 DB COM7 :
0063 74 151 DB COM8 :
152 :-----
0064 048F 153 COM0: JMP RESET : reset command
0066 0497 154 COM1: JMP RPDL : read power detect line
0068 04A9 155 COM2: JMP START2 : not assigned
006A 04B4 156 COM3: JMP CTFC : command tuner frequency change
006C 04D4 157 COM4: JMP SHID : send message to device response
006E 244C 158 COM5: JMP SPC : subscriber power/cable control
0070 0449 159 COM6: JMP START2 : not assigned
0072 247F 160 COM7: JMP SDPS : define drop poll sequence
0074 24D4 161 COM8: JMP SDEPS : define device poll sequence
162 :-----
0076 E857 163 : 84 Command response :
0078 F0 164 CONT1: MOV R0,8FOPR841 : 84 command was occurred
0079 F264 165 MOV R,8FA :
007B 5438 166 JBT CONT2 :
007D 4449 167 CALL RESP84 :
168 :-----
007F 2300 170 : 84 Command response :
171 STWPT3: MOV A,800H : Status flag 04 read

```

FILE: DROP7\_PST.VENHAFM NEWLETT-PACKARD: 8041 Assembler

LOCATION	OBJECT CODE LINE	SOURCE LINE
0081 90	172	MOV STS,A
0082 0449	173	JMP START2
	174 :	
0084 B826	175 CONT2	MOV R0,#SNOMES+1
0086 F0	176	MOV A,9R0
0087 F249	177	JBT START2
0089 D27F	178	JR6 STARTS
	179 :	
008B 341D	180	CALL RES04
	181 :	
008D 0449	182	JMP START2
	183 :	
	184 :*****	
	185 :*****	
009F BA00	186 PESET:	MOV R2,#00
0091 BB01	187	MOV R3,#01
0093 34FC	188	CALL RESOUT
0095 0411	189	JMP START0
	190 :*****	
	191 :	
0097 0E	192 RFDL:	MOVD A,P6
0098 530F	193	ANL A,#0FH
009A AB	194	MOV R3,A
009B 0F	195	MOVD A,P7
	196 :	
009C 47	197	SWAP A
009D 4B	198	ORL A,R3
009E B820	199	MOV R0,#PWRDET
00A0 A0	200	MOV 9R0,A
00A1 BA01	201	MOV R2,#01H
00A3 BB02	202	MOV R3,#02H
	203 :	
00A5 34FC	204	CALL RESOUT
00A7 14AB	205	CALL PS
00A9 0449	206	JMP START2
	207 :	
	208 :	
00AB B820	209 PS:	MOV R0,#PWRDET
00AD F0	210	MOV A,9R0
00AE 43C0	211	ORL A,#11000000AE
00F9 AA	212	MOV R2,A
00E1 54C0	213	CALL PWRCHK
00B3 83	214	RET
	215 :*****	
	216 :	
	217 :	
00B4 B821	218 CTFC:	MOV R0,#CHANNEL
00B6 BB03	219	MOV R3,#03H
00B8 3410	220	CALL INPCON
00BA 23FF	221	MOV A,#0FFH
00BC DB	222	XRL A,R3
00BD C64D	223	JZ START4
	224 :	
00BF B821	225	MOV R0,#CHANNEL
00C1 F0	226	MOV A,9R0
00C2 03FA	227	ADD A,#-06H
00C4 F649	228	JC START2

FILE: DROP7\_RSTIUENAPD HENLETT-PACAPD: 8041 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

229 ;
00C6 9466 230 CALL TUNEP ; Changing frequency
00C8 BA03 231 MOV R2,003H ;
00CA B802 232 MOV P3,002H ;
00CC B821 233 MOV R0,0CHANNEL ;
234 ;
00CE 34FC 235 CALL RESOUT ; Send to Data_Processor response " 03 "
236 ;
00D0 0449 237 JMP START2 ; return main routine
238 ;
239 ;-----
00D2 3C 240 ALLCNT: MOVD P4,A ; Select 6 subscriber
00D3 BAC0 241 MOV R2,00C0H ;
00D5 34AE 242 CALL SELECT ;
00D7 83 243 RET
244 ;-----
245 ; ( Send Message to Device )
00D8 344C 246 FINDB4: CALL WAIT_B4 ; If B4 CMD is exist, then send it to Data_Process
00DA B826 247 SMTD: MOV R0,0SNDMES+1 ;
00DC F0 248 MOV A,0R0 ; See that buffer for 04 command is empty
00DD F2D8 249 JBT FINDB4 ; If buffer is full, then this routine wait
00DF D2E3 250 SMTD0: JBE SMTD1 ; for sending to device by intr. routine
00E1 341D 251 CALL RES04 ; Send 04 response to Data Processor
252 ;
00E3 2310 253 SMTD1: MOV A,000010000B ; Set 04 command bus
00E5 90 254 MOV STS,A ;
00E6 C8 255 DEC P0 ;
00F7 B802 256 MOV R3,0002H ; input 2 byte ( device ID , BYTE COUNT )
00E9 3410 257 CALL INPCOM ;
00EB FB 258 MOV A,R3 ;
00ED D3FF 259 XRL A,00FFH ;
00EE C64D 260 JZ START4 ;
261 ;
00F0 B826 262 MOV R0,0SNDMES+1 ; See the number of send bytes
00F2 F0 263 MOV A,0P0 ; for ata processor
00F3 AB 264 MOV R3,A ;
265 ;
00F4 03F9 266 ADD A,0-7H ; If BYTE COUNT is greater than 6
00F6 E6FA 267 JNC SMTD4 ; then, input data was aborted
00F8 2438 268 JMP SMTD2 ; abort command ( illegal return )
269 ;
00FA 18 270 SMTD4: INC R0 ; input message data
00FB 3410 271 CALL INPCOM ;
272 ;
00FD FB 273 MOV A,R3 ;
00FE D3FF 274 XRL A,00FFH ;
0100 C67A 275 JZ START7 ;
276 ;
277 ;----- sub command set routine
0102 B827 278 MOV R0,0SNDMES+2 ; command address
0104 B924 279 MOV R1,0SUBMES ; Sub. message for intr. routine
0106 F0 280 MOV A,0R0 ;
0107 33F8 281 ANL A,00F8H ;
0109 77 282 RR A ;
010A 77 283 RP A ;
010B 77 284 RR A ;
010C AA 285 MOV R2,A ;

```



FILE: DROP7\_PST:UEHARA HEWLETT-PACKARD: 8041 Assembler

0167237

LOCATION OBJECT CODE LINE SOURCE LINE

```

010D 031F      286      XRL      A,#1FH      ;
010F C62D      287      JZ       EXPAND      ;
0111 FA        288      MOV      A,R2      ;
0112 97        289      CLR      C          ;
0113 67        290      RRC      A          ;
0114 033C      291      ADD      A,#FNCTBL     ;
0116 A3        292      MOVP     A,9A      ;
0117 A1        293      MOV      @R1,A      ;
0118 FA        294      MOV      A,R2      ;
0119 1231      295      JBC      ODDFNC      ;
011B 230F      296      MOV      A,#0FH      ;
011D 51        297      ANL      A,@P1      ;
011E A1        298      MOV      @R1,A      ;
299 ;
300 ;
011F B826      301 SUBCOM:  MOV      R0,#SNDMES+1 ;
0121 F0        302      MOV      A,@R0      ;
0122 43C0      303      ORL      A,#0C0H      ; Set n4 Buffer full ( active )
0124 A0        304      MOV      @R0,A      ;
305 ;
306 ;      count down R5 / Count time which n4 command occured
307 ;
0125 FD        308      MOV      A,R5      ;
0126 962A      309      JNZ      SET_R5      ;
0128 BD04      310      MOV      R5,#COUNT_R5+1 ;
012A CD        311 SET_R5:  DEC      R5      ;
312 ;
313 ;
012B 0449      314      JMP      START2      ;
315 ;
012D B102      316 EXPAND:  MOV      @R1,#02H      ; expand command is fired .
012F 241F      317      JMP      SUBCOM      ; send to device
0131 23F0      318 ODDFNC:  MOV      A,#0F0H      ;
0133 51        319      ANL      A,@R1      ;
0134 47        320      SWAP     A          ;
0135 A1        321      MOV      @R1,A      ;
0136 241F      322      JMP      SUBCOM      ;
323 ;
0138 B040      324 SMTD2:  MOV      @P0,#40H      ; Set status " buffer empty "
013A 0449      325      JMP      START2      ;
326 ;
327 ;      Kind of function define table
328 ;      number of command are as follow.
329 ;      1 ---- device control
330 ;      2 ---- send device data
331 ;      3 ---- read device information
332 ;
333 ;      ; command number
013C 23        334 FNCTBL:  DB      23H      ; 1.0
013D 22        335      DB      22H      ; 3.2
013E 22        336      DB      22H      ; 5.4
013F 21        337      DB      21H      ; 7.6 Specified
0140 32        338      DB      32H      ; 9.8
0141 32        339      DB      32H      ; B.A
0142 11        340      DB      11H      ; D.C
0143 11        341      DB      11H      ; F.E device control
0144 11        342      DB      11H      ; 11.10

```

FILE: DROP7\_RST:UEHAPA HEWLETT-PACKARD: 8041 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

0145 22      343      DB      22H      ; 13,12
0146 22      344      DB      22H      ; 15,14  send data n to device
0147 22      345      DB      22H      ; 17,16      n = 1 to 5
0148 22      346      DB      22H      ; 19,18
0149 33      347      DB      33H      ; 1B,1A
014A 33      348      DB      33H      ; 1D,1C  read device information
014B 33      349      DB      33H      ; 1F,1E
014B 33      350      ; other send data
351 ;*****
352 ; ( Subscriber power control & Subscriber Switch Control )
353 ;
014C B82D    354 SPC:  MOV     R0,#SUBPWR ;
014E B801    355      MOV     R3,#01H      ;
0150 5410    356      CALL    INPCOM      ; input
357 ;
0152 FB      358      MOV     A,R3          ;
0153 D3FF    359      XRL     A,#0FFH      ; Check Error indicator.
0155 C67A    360      JZ      START7      ;
361 ;
0157 B82D    362      MOV     R0,#SUBPWR      ;
0159 F0      363      MOV     A,#R0          ;
015A 5307    364      ANL     A,#07H          ;
015C AB      365      MOV     R3,A          ; Drop Number
015D AC      366      MOV     R4,A          ;
015E F0      367      MOV     A,#R0          ;
015F F272    368      JB7     SPC0          ; bit 7 equal 1- power on 0- power off
369 ;
0161 54BC    370 SPC1:  CALL    PWROFF      ;
371 ;
372 ;
0163         373 SPCCOM:
0163 FC      374      MOV     A,P4          ;
0164 AB      375      MOV     R3,A          ; Restores Converter Number
0165 F0      376      MOV     A,#R0          ;
0166 D276    377      JB6     SSC1          ; bit 6 equal 1- sel. cable A
378 ;                                0- sel. cable B
0168 54C0    379 SSC0:  CALL    CABLEA      ;
380 ;
016A         381 SSCOM:
382 ;
016A BA05    383      MOV     R2,#05H          ; Send response " 05 "
016C BB02    384      MOV     R3,#02H          ;
016E 34FC    385      CALL    RESOUT      ; P0 -- SUBPWR
0170 0449    386      JMP     START2      ;
387 ;
0172 54B4    388 SPC0:  CALL    PWRON        ;
0174 2463    389      JMP     SPCCOM      ;
390 ;
0176 54C4    391 SSC1:  CALL    CABLEB      ;
0178 246A    392      JMP     SSCOM      ;
393 ;
394 ;
017A 044D    395 START7:  JMP     START4          ;
396 ;*****
397 ; Define Drop Poll Sequence )
398 ;
017C BBFF    399 CHGFAL:  MOV     R3,#0FFH      ;

```

FILE: DROPT\_PST:UEHAPA HEMLETT-PACKARD: 9041 Assembler

0167237

LOCATION OBJECT CODE LINE SOURCE LINE

```

017E 83      400      PET      :
              401 ;
017F B831    402 SDPS:  MOV     R0,#DRPPOL :
0181 B803    403      MOV     R3,#03      :
              404 ;
0183 3494    405      CALL    CHANGE      :
              406 ;
0185 FB      407      MOV     A,R3      :
0186 D3FF    408      XRL     A,#0FFH      :
0188 C67A    409      JZ      START7      :
              410 ;
018A BA07    411      MOV     R2,#07H      :
018C BB01    412      MOV     R3,#01H      :
018E 34FC    413      CALL    RESOUT      :
0190 0449    414      JMP     START2      :
              415 ;
0192 0450    416 STAPT9:  JMP     START3      :
              417 ;
0194 D694    418 CHANGE:  JNIBF   CHANGE      : Change Drop poll map format
0196 767C    419      JF1     CHGFAL      :
0198 22      420      IN      A,DBB      :
0199 A0      421      MOV     @R0,A      :
019A 72B5    422      JB3     NOPOL      :
              423 ;
019C 47      424 RETPOL:  SWAP    A      :
019D 18      425      INC     R0      :
019E A0      426      MOV     @P0,A      :
              427 ;
019F 18      428      INC     R0      :
01A0 EB94    429      DJNZ    R3,CHANGE      :
              430 ;
01A2 D6A2    431 POLMOD:  JNIBF   POLMOD      :
01A4 767C    432      JF1     CHGFAL      :
01A6 22      433      IN      A,DBB      :
              434 ;
01A7 2A      435      XCH     A,R2      :
01A8 B931    436      MOV     R1,#DRPPOL      :
01AA F1      437      MOV     A,@P1      :
01AB A0      438      MOV     @P0,A      :
01AC 2A      439      XCH     A,R2      :
              440 ;
01AD 34C9    441      CALL    SETP7      :
              442 ;
01AF C8      443      DEC     R0      :
01B0 F0      444      MOV     A,@R0      :
01B1 4380    445      ORL     A,#80H      :
01B3 A0      446      MOV     @R0,A      :
              447 ;
01B4 83      448 CHGEND:  RET      :
              449 ;
              450 ;
01B5 2A      451 NOPOL:  XCH     A,R2      :
01B6 FB      452      MOV     A,R3      :
01B7 D303    453      XRL     A,#03H      :
01B9 C6C1    454      JZ      RETSTP      :
              455 ;
01BB C8      456      DEC     R0      :

```

FILE: DROPT\_RST:UEWAPA HEWLETT-PACKARD: 5041 Assembly

LOCATION	OBJECT CODE	LINE	SOURCE LINE
018C F0	457	MOV	A,0P0 :
018D 4390	458	ORL	A,080H :
018F A0	459	MOV	0P0,A :
	460 ;		
01C0 18	461	INC	R0 :
	462 ;		
01C1 2A	463	PETSTP: XCH	A,R2 :
01C2 249C	464	JMP	RETPOL :
	465 ;		
	466 ;		
01C4 F1	467	RNDPBN: MOV	A,0P1 :
01C5 53DF	468	ANL	A,011011111E :
01C7 A1	469	MOV	0P1,A :
01C8 83	470	RET	:
	471 ;		
01C9 D3FF	472	SETP7: XRL	A,00FFH :
01CB B91F	473	MOV	R1,031 :
01CD 96C4	474	JNZ	RNDPBN :
	475 ;		
01CF F1	476	MOV	A,0P1 :
01D0 4320	477	ORL	A,000100000B :
01D2 A1	478	MOV	0P1,A :
01D3 83	479	PET	:
	480 ;		
	481 ;		
	482 ;		
	483 ;	*****	
	484 ;	Define Device Poll Sequence >	
	485 ;		
01D4 D6D4	486	SDEPS: JNIBF	SDEPS :
01D6 76FA	487	JF1	START8 :
01D8 B838	488	MOV	R0,0DEVPOL :
01DA 22	489	IN	A,DBB :
01DB 5307	490	ANL	A,007H :
01DD AB	491	MOV	R3,A :
01DE AC	492	MOV	R4,A :
01DF C6E7	493	JZ	SDEPS1 :
	494 ;		
01E1 F8	495	SDEPS0: MOV	A,R0 :
01E2 0305	496	ADD	A,005H :
01E4 A8	497	MOV	R0,A :
01E5 EBE1	498	DJNZ	R3,SDEPS0 :
	499 ;		
01E7 B805	500	SDEPS1: MOV	R3,005H :
01E9 5410	501	CALL	INPCOM :
01EB FB	502	MOV	A,R3 :
01EC D3FF	503	XRL	A,00FFH :
01EE C6FA	504	JZ	START8 :
	505 ;		
01F0 BA08	506	MOV	R2,008H :
01F2 B802	507	MOV	R3,002H :
01F4 B804	508	MOV	R0,004H :
01F6 34FC	509	CALL	RESOUT :
01F8 0449	510	JMP	START2 :
	511 ;		
01FA 044D	512	START8: JMP	START4 :
	513 ;	*****	

FILE: DROP7\_PST:UEHAPA HEMLETT-PACKARD: 8041 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

514 ;----- Response Output Routine -----
01FC 86FC 515 RESOUT: JOBF RESOUT : Check olut buffer full ?
01FE 95 516 CPL F0 :
01FF FA 517 MOV A,R2 :
0200 02 518 OUT DBB,A : output .Command....
519 :
0201 C8 520 DEC R3 :
0202 FB 521 MOV A,R3 :
522 :
0203 C60D 523 JZ RESEND : Command only
524 :
0205 8605 525 RESCNT: JOBF RESCNT :
0207 83 526 CLR F0 :
0208 F0 527 MOV A,@R0 :
0209 02 528 OUT DBB,A : output .data....
020A 18 529 INC R0 :
020B EB0E 530 DJNZ R3,RESCNT :
020D 83 531 RESEND: RET :
020E 4405 532 RESCNT: JMP RESCNT :
533 :
534 ;----- input command and data -----
535 :
536 :
537 : R0 ----- response Data head address
538 : R3 ----- Bytes of input data
0210 D610 539 INPCOM: JNIBF INPCOM :
0212 761A 540 JF1 INPEND : coming data is not a command
0214 22 541 IN A,DBB : input.....
0215 A0 542 MOV @R0,A : Store Data
0216 18 543 INC R0 :
0217 EB10 544 DJNZ R3,INPCOM :
0219 83 545 RET :
021A BBFF 546 INPEND: MOV R3,#0FFH : P3=0ffh
021C 83 547 PET : data failure
548 :
549 :
550 :
551 : 04 response output routine
552 :
553 :
021D F0 554 RES04: MOV A,@R0 :
021E C62F 555 JZ SD1 : error message
556 :
557 : ADD A,#-7
558 : JC S04END
559 :
0220 F0 560 MOV A,@R0 :
0221 0303 561 ADD A,#03H : + Device ID command BYTE COUNT
562 :
0223 AB 563 SD2: MOV R3,A :
0224 BA04 564 MOV R2,#04H :
0226 B825 565 MOV R0,#SNDMES :
0228 34FC 566 CALL PESOUT : response
567 :
022A B826 568 S04END: MOV R0,#SNDMES+1 :
022C B040 569 MOV @R0,#40H : clear 04 response for next data.
022E 83 570 RET

```

FILE: DROP7\_PST:UEHAPR HENLETT-PACKAPD: 3041 M55embler

LOCATION OBJECT CODE LINE SOURCE LINE

```

571 :
572 :
022F 2304 573 SD1: MOV A,#004H : Error message
0231 4423 574 JMP SD2 : same as 84 Command
575 :
576 :-----
577 : Response 84 Command
578 :
0233 579 RES_84:
0233 8857 580 MOV R0,#FOR84+1 ;
0233 F0 581 MOV A,#P0 ;
0236 F247 582 JB7 END_84 ;
583 :
0238 C648 584 RESP84: JZ F84FAL : Called at main loop running.
585 :
023A F0 586 MOV A,#R0 ;
0238 0303 587 ADD A,#03H ;
023D AB 588 MOV R3,A : store BYTE COUNT for send
589 :
023E C8 590 F84ERR: DEC R0 ;
591 :
023F BA84 592 MOV P2,#64H ;
0241 34FC 593 CALL RESOUT : Response out
594 :
0243 8857 595 S84END: MOV R0,#FOR84+1 ;
0243 8080 596 MOV @R0,#080H : reset 84 command
0247 83 597 END_84: PET ;
598 :
599 :
0248 8804 600 F84FAL: MOV R3,#04 : if VLF communication is failed.
024A 443E 601 JMP F84ERR : send that condition to data process
602 :
603 WAIT_84:
024C FD 604 MOV A,P5 ;
024D 9653 605 JNZ WAIT_END : If P5 = 0 then look 84 buffer
024F 5433 606 CALL RES_84 : send 84 command
0251 8D03 607 MOV P5,#COUNT_P5 : initialize P5 counter
0253 608 WAIT_END:
0253 83 609 PET ;
610 :-----
0254 8820 611 INIT_P: MOV R0,#PWRIET : Power Detect line initialization
0256 80C0 612 MOV @R0,#0CAH ;
0258 14AB 613 CALL P? : Call subscribers power detect
025A 83 614 PET ;
615 :
616 :----- Change Converter Number to bit pattern -----
617 :
618 :
025B 8AFE 619 BITSEL: MOV R2,#0FEH : P3: Drop on Converter Num.
025D FB 620 MOV A,R3 : P2: Bit pattern - Active Low
025E C665 621 JZ CON0 : 4-bit Converter 3
0260 FA 622 MOV A,P2 : 1111 0111 B
0261 E7 623 TUNLP1: RL A ;
0262 EB61 624 DJNZ R3,TUNLP1 ;
0264 AA 625 MOV R2,A ;
0265 83 626 CON0: RET ;
627 :

```

FILE: DROP7\_PST:UEHAPA HEWLETT-PACKARD: 3041 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

628 :-----
629 :
630 : Change Tuner freq.
631 :
632 : Used Register
633 : R0 --- Indicate Channel Command - 07 command
634 : R2 --- Converter Select
635 : R3 --- Working
636 :
637 :
638 :
0266 B821 639 TUNER: MOV R0,#CHANNEL
0268 F0 640 MOV A,R0 : 0F0 -- Converter number
0269 AB 641 MOV R3,A
642 :
026A 545B 643 CALL BITSEL
644 :
026C B823 645 MOV R0,#CHANNEL*2
026E B802 646 MOV P3,#02 : 0F0 -- Main Counter 2 bits
0270 548F 647 TUNLP3: CALL DATOUT
0272 EB70 648 DJNZ R3,TUNLP3
649 :
0274 F0 650 MOV A,R0 : Abort one bit in 0F0
0275 E7 651 RL A
0276 A0 652 MOV 0F0,A
653 :
0277 C8 654 DEC P0 : 0F0 -- Main Counter 11
0278 B808 655 MOV R3,#08
027A 548F 656 TUNLP2: CALL DATOUT
027C EB7A 657 DJNZ R3,TUNLP2
658 :
027E 18 659 INC P0
027F B805 660 MOV P3,#05
0281 548F 661 TUNLP4: CALL DATOUT : Swallow counter
0283 EB81 662 DJNZ R3,TUNLP4
663 :
0285 230A 664 MOV A,#LOADWT : Load pulse
0287 54A5 665 CALL PULSE
666 :
0289 2301 667 MOV A,#DAT_0 : Clear Data
028B 3C 668 MOVD P4,A
028C 54AE 669 CALL SELECT
028E 83 670 RET
671 :-----
028F 97 672 DATOUT: CLR C
0290 F0 673 MOV A,0F0
0291 F7 674 CIRCLE0: RLC A
0292 A0 675 MOV 0F0,A
0293 2309 676 MOV A,#DAT_1 : Data 0 Function set Data 1
0295 3C 677 MOVD P4,A
0296 F69B 678 JC DATA1 : if output data is 0
0298 2307 679 MOV A,#07H : then invert a data
029A 9C 680 ANLD P4,A : that recently outputted
681 :
029B FA 682 DATA1: MOV A,R2 : Select high
029C 39 683 OUTL P1,A
029D 23FF 684 MOV A,#0FFH

```

FILE: DROP7\_PST:MEMAPA HENLETT-PACKARD: 8041 Assembler

0167237

LOCATION	OBJECT CODE	LINE	SOURCE LINE	
029F 39	685	OUTL	P1,A	: Select Low
	686 ;			
02A0 54A3	687	CALL	CLOCK	:
	688 ;			
02A2 83	689	RET		:
	690 ;			
02A3 2308	691	CLOCK: MOV	A,#CLKDAT	:
02A5 3C	692	PULSE: MOVD	P4,A	: Clock High
02A6 FA	693	MOV	A,P2	:
02A7 39	694	OUTL	P1,A	: Select high
02A8 23FF	695	MOV	A,#0FFH	:
02AA 39	696	OUTL	P1,A	: Select low
	697 ;			
02AB 2307	698	MOV	A,#07H	: Clock Low
02AD 9C	699	WNL	P4,A	:
02AE FA	700	SELECT: MOV	A,R2	: Select high
02AF 39	701	OUTL	P1,A	:
02B0 23FF	702	MOV	A,#0FFH	:
02B2 39	703	OUTL	P1,A	: Select low
02B3 83	704	RET		:
	705 ;			
02B4 230C	706	PMFON: MOV	A,#PWRDT1	: Power Cable Power check
02B6 3C	707	CONCOM: MOVD	P4,A	:
	708 ;			
02B7 545B	709	CALL	BITSEL	: SET P3 --- Converter Number
02B9 54AE	710	CALL	SELECT	:
02BB 83	711	RET		:
02BC 2304	712	PWPOFF: MOV	A,#PWRDT0	:
02BE 44B6	713	JMP	CONCOM	:
	714 ;			
02C0 2303	715	CABLEA: MOV	A,#CABL_A	: Select RF cable A
02C2 44B6	716	JMP	CONCOM	:
	717 ;			
02C4 230B	718	CABLEB: MOV	A,#CABL_B	: Select RF cable B
02C6 44B6	719	JMP	CONCOM	:
	720 ;			
02C8 230D	721	PWRCHK: MOV	A,#DETDTAT	: Power Check
02CA 3C	722	MOVD	P4,A	:
02CB 54AE	723	CALL	SELECT	:
02CD 83	724	RET		:
	725 ;			
		END		

Errors= 0



FILE: AKI:SHIGI .. HEWLETT-PACKARD: 8048 Assembler

0167237

LOCATION OBJECT CODE LINE SOURCE LINE

```

1 "8048"
2 ;Last Ver.(AKI)
3 ;
4 ;XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX82043810XXXX
5 ;
6 ;
7 ;
8 ; Drop Processor ( 8042 )
9 ;
10 ; timer interrupt routine. ver 2.2.1
11 ;
12 ; [ Hot ver. ] + 04_An by Hideo Shigihara.
13 ;XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX82043810XXXX
14 ;
15 ;
16 ;XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
17 ;
18 ; --- Register bank 1 ---
19 ;
20 ;XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
21 ;
22 ; ***** R0 : Working resister. *****
23 ;
24 ; ***** R1 : Working resister. *****
25 ;
26 ; ***** R2 : Data (bit) counter. *****
27 ;
28 ; ***** R3 : Transmit or receive data buffer. *****
29 ;
30 ; ***** R4 : Current access drop map address. *****
31 ;
32 ; ***** R5 : Current access device map address. *****
33 ;
34 ; ***** R6 : VLF flags. *****
35 ;
36 ; (bit0) = Error counter 0.
37 ;
38 ; (bit1) = Error counter 1.
39 ;
40 ; (bit2) = Error counter 2.
41 ;
42 ; (bit3) = --- No used. ---
43 ;
44 ; (bit4) = --- No used. ---
45 ;
46 ; (bit5) = --- No used. ---
47 ;
48 ; (bit6) = RCK flag.
49 ;
50 ; (bit7) = --- No used. ---
51 ;
52 ; ***** R7 : Polling flag *****
53 ;
54 ; (bit0) = Return wait flag.
55 ;
56 ; (bit1) = No request flag.
57 ;

```

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT	CODE	LINE	SOURCE	LINE
			58	;	\\
			59	;	\\
			60	;	\\
			61	;	\\
			62	;	\\
			63	;	\\
			64	;	\\
			65	;	\\
			66	;	\\
			67	;	\\
			68	;	\\
			69	;	\\
			70	;	\\
			71	;	\\
			72	;	\\
			73	;	\\
			74	;	\\
			75	;	\\
			76	;	\\
			77	;	\\
			78	;	\\
			79	;	\\
			80	;	\\
			81	;	\\
			82	;	\\
			83	;	\\
			84	;	\\
			85	;	\\
			86	;	\\
			87	;	\\
			88	;	\\
			89	;	\\
			90	;	\\
			91	;	\\
			92	;	\\
			93	;	\\
			94	;	\\
			95	;	\\
			96	;	\\
			97	;	\\
			98	;	\\
			99	;	\\
			100	;	\\
			101	;	\\
			102	;	\\
			103	;	\\
			104	;	\\
			105	;	\\
			106	;	\\
			107	;	\\
			108	;	\\
			109	;	\\
			110	;	\\
			111	;	\\
			112	;	\\
			113	;	\\
			114	;	\\

0007 6400

<0024>	89	SDMSGK	EQU	24H	:Submessage for device response. (Command only, WR or RD data.)
<0025>	92	SDMSGH	EQU	25H	:04 command buffer ( ID. )
<0026>	95	SDMSGI	EQU	26H	:04 command buffer ( byte count. )
<0027>	98	SDMSGC	EQU	27H	:04 command buffer ( command. )
<0031>	101	DRMAP0	EQU	31H	:Drop polling map ( 2.0 )
<0036>	104	DRMAP5	EQU	36H	:Drop polling map ( 2.5 )
<0037>	107	DRMAPH	EQU	37H	:Drop polling map ( 2.H )
<0038>	110	DVM10	EQU	38H	:Device polling map ( 1.0.0 )
<003D>	113	DVM11	EQU	3DH	:Device polling map ( 1.1.0 )

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

115 ;
<0042> 116 DVM12 EQU 42H ;Device polling map ( 1.2.0 )
117 ;
118 ;
<0047> 119 DVM13 EQU 47H ;Device polling map ( 1.3.0 )
120 ;
121 ;
<004C> 122 DVM14 EQU 4CH ;Device polling map ( 1.4.0 )
123 ;
124 ;
<0051> 125 DVM15 EQU 51H ;Device polling map ( 1.5.0 )
126 ;
127 ;
<0056> 128 RE84H EQU 56H ;84 command buffer ( ID. )
129 ;
130 ;
<0057> 131 RE84I EQU 57H ;84 command buffer ( byte count. )
132 ;
133 ;
<0058> 134 RE84C EQU 58H ;84 command buffer ( data 0. )
135 ;
136 ;
<005D> 137 TXBUF EQU 5DH ;Transmissive data buffer.
138 ;
139 ;
<005E> 140 DEMAP0 EQU 5EH ;Device polling map ( 2.N.0 ).
141 ;
142 ;
<0065> 143 DEMAP7 EQU 65H ;Device polling map ( 2.N.7 ).
144 ;
145 ;
<0067> 146 DEMAPH EQU 67H ;Device polling map ( 2.N.H ).
147 ;
148 ;
<0068> 149 LAVI EQU 68H ;Indirect addressing data buffer.
150 ;
151 ;
<0069> 152 ANSPAR EQU 69H ;Parity flag .
153 ;
154 ;
<006A> 155 POLING EQU 6AH ;Current access device & drop
156 ; ; number set buffer.
157 ;
<006E> 158 CNTBY EQU 6BH ;Byte counter for Rx or Tx.
159 ;
160 ;
<006C> 161 SAVDRP EQU 6CH ;Drop number save buffer.
162 ;
163 ;
164 ;
165 ;-----
166 ;
167 ; ORG 300H
168 ;-----
169 ;-----
170 ;-----
171 ;

```

HEWLETT-PACKARD: 8048 Assembler

**SOURCE LINE**

```

172 ;***** INDIRECT ADDRESSING ROUTINE. *****
173 ;
174 METIT: XCH A,R7 :Jumping address set.
175 ;
0301 D5 176 SEL R81 :Register bank change.
177 ;
0302 0305 178 ADD A,@NEGIH :Indirect addressing jump.
0304 B3 179 JMP QA ;
180 ;
181 ;
182 ;*****
183 ;
184 ;-----
185 ;
186 ;***** INDIRECT ADDRESSING TABLE. *****
187 ;
188 ;
0305 2527292B2D 189 NEGIH: DB A0, A1, A2, A3, A4, A5, A6, A7
190 ;
191 ;
030D 3537393B3D 192 DB A8, B9,B10,C11,C12,C13,C14,C15
193 ;
194 ;
0315 4547494B4D 195 DB C16,C17,C18,C19,D20,D21,D22,D23
196 ;
197 ;
031D 5557595B5D 198 DB D24,D25,D26,D27,D28,E29,E30,F31
199 ;
200 ;
201 ;*****
202 ;
203 ;-----
204 ;|
205 ;|
206 ;|***** JUMP TABLE FOR TIMER INTERRUPT. *****|
207 ;|
208 ;| ( I N D E X ) |
209 ;|
0325 649A 210 A0: JMP CPCMO :[#0] : Conditional poll command
211 ;| set & start bit Tx routine
212 ;| [ L.No 423 ]
213 ;|
0327 64E3 214 A1: JMP DW80 :[#1] : Transmissive data Tx
215 ;| routine.
216 ;| [ L.No 519 ]
217 ;|
0329 64B5 218 A2: JMP M100 :[#2] : Message indicator bit Tx
219 ;| routine.
220 ;| [ L.No 456 ]
221 ;|
032B 64FE 222 A3: JMP PALB0 :[#3] : Last bit of transmissive
223 ;| data Tx routine.
224 ;| [ L.No 556 ]
225 ;|
032D 6465 226 A4: JMP MTMINT :[#4] : Drop select & start bit Tx
227 ;| routine.
228 ;| [ L.No 355 ]

```

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

032F 841A	229 ;			
	230 A5:	JMP	PARBT	:[#5] : Parity bit Tx routine.
	231 ;			
	232 ;		[ L.No 604 ]	
	233 ;			
0331 8411	234 A6:	JMP	STOP0	:[#6] : Stop bit Tx routine.(1)
	235 ;			
	236 ;		[ L.No 585 ]	
	237 ;			
0333 8439	238 A7:	JMP	ACK1	:[#7] : ACK receive & check routine.(1)
	239 ;			
	240 ;		[ L.No 655 ]	
	241 ;			
0335 8422	242 A8:	JMP	RCK	:[#8] : RCK receive & check routine.
	243 ;			
	244 ;		[ L.No 624 ]	
	245 ;			
0337 C47F	246 B9:	JMP	ACK4	:[#9] : ACK check 4. (disposal of 04 command.)
	247 ;			
	248 ;		[ L.No 1456 ]	
	249 ;			
0339 A4E8	250 B10:	JMP	COM04D	:[#10] : 04 command data Tx. (disposal of 04 command.)
	251 ;			
	252 ;		[ L.No 1241 ]	
	253 ;			
033B 848E	254 C11:	JMP	KEYDAY	:[#11] : Start bit Tx. (Rx routine.)
	255 ;			
	256 ;		[ L.No 740 ]	
	257 ;			
033D 848B	258 C12:	JMP	PALK	:[#12] : Parity bit Rx. (Rx routine.)
	259 ;			
	260 ;		[ L.No 814 ]	
	261 ;			
033F 8498	262 C13:	JMP	RSTAT	:[#13] : Start bit erase. (Rx routine.)
	263 ;			
	264 ;		[ L.No 760 ]	
	265 ;			
0341 84A2	266 C14:	JMP	PBSET	:[#14] : Receivable data Rx. (Rx routine.)
	267 ;			
	268 ;		[ L.No 780 ]	
	269 ;			
0343 84DE	270 C15:	JMP	ACK0T	:[#15] : ACK bit Tx. (1) (Rx routine.)
	271 ;			
	272 ;		[ L.No 855 ]	
	273 ;			
0345 A4AE	274 C16:	JMP	STGN84	:[#16] : Stop bit Tx 6. continue 84 command data Rx
	275 ;			
	276 ;		[ L.No 1137 ]	
	277 ;			
0347 A43A	278 C17:	JMP	NCK0T	:[#17] : NCK Tx. (Rx routine.)
	279 ;			
	280 ;		[ L.No 999 ]	
	281 ;			
0349 A4BE	282 C18:	JMP	STGN04	:[#18] : Stop bit Tx 7. continue 04 command data Rx
	283 ;			
	284 ;		[ L.No 1137 ]	
	285 ;			

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

034B C43E      286 C19:    JMP      ACK3      ;[#19] : ACK check 3.
                287 ;;                      (Rx routine.)
                288 ;;      [ L.No 1393 ]
                289 ;;
034D A4D4      290 D20:    JMP      COM04      ;[#20] : Start bit Tx.
                291 ;;                      (04 command.)
                292 ;;      [ L.No 1215 ]
                293 ;;
034F A406      294 D21:    JMP      STER04      ;[#21] : Stop bit Tx 3.
                295 ;;                      disposal of 84 com error.
                296 ;;      [ L.No 922 ]
                297 ;;
0351 84F8      298 D22:    JMP      STER04      ;[#22] : Stop bit Tx 2.
                299 ;;                      disposal of 04 com error.
                300 ;;      [ L.No 900 ]
                301 ;;
0353 A49A      302 D23:    JMP      STGR04      ;[#23] : Stop bit Tx 5.
                303 ;;                      84 com all ok & end.
                304 ;;      [ L.No 1110 ]
                305 ;;
0355 A424      306 D24:    JMP      STGR04      ;[#24] : Stop bit Tx 4.
                307 ;;                      04 com all ok & end.
                308 ;;      [ L.No 965 ]
                309 ;;
0357 84EC      310 D25:    JMP      REPRX      ;[#25] : Stop bit Tx 1.
                311 ;;                      challenge once more.
                312 ;;      [ L.No 878 ]
                313 ;;
0359 A459      314 D26:    JMP      LCIN       ;[#26] : Last character indicator
                315 ;;                      check.
                316 ;;      [ L.No 1038 ]
                317 ;;
035B E434      318 D27:    JMP      IDLINT      ;[#27] : Wait routine for 84 com. test.test
                319 ;;                      ( No 1 )
                320 ;;      [ L.No 1684 ]
                321 ;;
035D E416      322 D28:    JMP      DSCF04      ;[#28] : Drop scan for 84 command.
                323 ;;
                324 ;;      [ L.No 1629 ]
                325 ;;
035F E477      326 E29:    JMP      DSF04C      ;[#29] : Drop scan for 04 command.
                327 ;;
                328 ;;      [ L.No 1765 ]
                329 ;;
0361 E44B      330 E30:    JMP      NDPS04      ;[#30] : Changing operation to 84.
                331 ;;
                332 ;;      [ L.No 1713 ]
                333 ;;
0363 64CE      334 F31:    JMP      SMLINC      ;[#31] : Life sample.
                335 ;;
                336 ;;      [ L.No 492 ]
                337 ;;
                338 ;;
                339 ;|#####|
                340 ;|
                341 ;|#####|
                342 ;|

```

FILE: AKI:SHIGI

HEWLETT-PACKARD: 9949 Assembler

0167237

LOCATION OBJECT CODE LINE SOURCE LINE

```

343 ;
344 ;%
345 ;%==== CONDITIONAL-POLL.CONDITIONAL-POLL.CONDITIONAL-POLL. ====;%
346 ;%
347 ;
348 ;
349 ;
350 ;
351 ; ( DROP SELECT & START BIT SET. )
352 ; #A4
353 ;
354 ;
355 ;
0365 00 356 MTMINT: NOP
0366 266C 357 JNT0 ETDSR ;Detect service request
358 ; from SPU.
359 ;
360 ;
0368 D40B 361 CALL TSET1 ;1 bit time counter set & start.
036A 6489 362 NOTMAP: JMP DVMNS ;( no request ! )
363 ;
364 ; ( request ! )
036C D40B 365 ETDSR: CALL TSET1 ;1 bit time counter set & start.
366 ;
036E B831 367 MOV R0,#DRMAP0 ;Drop map set or not.
0370 F0 368 MOV A,R0
0371 726A 369 JB3 NOTMAP
370 ;
0373 F4B6 371 CALL DEVCH ;Changing the device map.
372 ;
0375 BD5E 373 MOV R5,#DEMAP0 ;First device select.
374 ;
375 ;
0377 FD 376 DMSRE: MOV A,R5 ;Next device select.
0378 A8 377 MOV R0,A
0379 F0 378 MOV A,R0
037A B867 379 MOV R0,#DEMAPH ;Device map 1 set or not ?
037C A0 380 MOV R0,A
037D D3FF 381 XRL A,#0FFH
037F C689 382 JZ DVMNS
383 ;
384 ; ( set ! )
0381 D422 385 CALL PARCLL ;Parity flag clear
386 ; & VLF flags clear.
0383 D414 387 CALL VLF00 ;Start bit "0" set.
388 ;
0385 2300 389 MOV A,#0 ;***NEXT [CPCMD]***
0387 C4EF 390 JMP JMPR ;RETP.
391 ;
392 ; ( No request or not set ! )
0389 FF 393 DVMNS: MOV A,R7
038A 4302 394 ORL A,#02H ;Drop scan flag set.
038C AF 395 MOV R7,A
396 ;
038D B4FF 397 CALL BCNTBC ;04 command set or not ?
038F F293 398 JB7 SF04D
0391 C4F2 399 JMP NTDRP ;( Not set ! )

```

FILE: AKI:SNIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

400 ;
401 ;
0393 FF      402 SF04D:  MOV     A,R7
0394 4304    403         ORL     A,#04H
0396 AF      404         MOV     R7,A
0397 E459    405         JMP     INT04S      ;Disposal of 04 command.
                                         ***NEXT [CON04]***
406 ;
407 ;
408 ;
409 ;
410 ;-----
411 ;
412 ;      (  CONDITIONAL POLL COMMAND SET : START BIT SET.  )
413 ;
414 ;-----
415 ;
416 ;
417 ;
0399 58      418 CPCOM:  DB      58H
419 ;
420 ;-----
421 ;
422 ;
423 ;
039A F8      424 CPCMO:  MOV     A,R0      ;Start bit trans.
039B 3D      425         MOVD    PS,A
426 ;
427 ;-----
428 ;
039C D40B    428         CALL    TSET1      ;1 bit time counter set & start.
429 ;
430 ;
039E 2399    430         MOV     A,#CPCOM      ;Conditional poll command set.
03A0 A3      431         MOVP    A,0A      ;( Transmissive data set. )
03A1 A9      432         MOV     R1,A
433 ;
03A2 B867    433         MOV     R0,#DENAPH  ;[#TXBUF] --- conditional poll
03A4 F0      434         MOV     A,R0      ; Command + device address.
03A5 530F    435         ANL     A,#0FH
436 ;
03A7 49      436         ORL     A,R1
437 ;
03A8 B85D    437         MOV     R0,#TXBUF
438 ;
03AA A0      438         MOV     @R0,A
439 ;
440 ;
03AB B868    440         MOV     R0,@LAV1    ;Indirect addressing buffer set.
03AD B007    441         MOV     @R0,#7
442 ;
443 ;
03AF D414    443         CALL    VLF00      ;MI bit "0" set.
444 ;
445 ;
03B1 2302    445         MOV     A,#2
446 ;
03B3 C4EF    446         JMP     JMPR      ;***NEXT [MI00]***
                                         :RETR.
447 ;
448 ;
449 ;
450 ;-----
451 ;
452 ;      (  MESSAGE INDICATOR BIT Tx .  )
453 ;
454 ;-----
455 ;
456 ;-----

```



FILE: AKI:SHIGI

HEWLETT-PACKARD: 6045 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
0385 F8	457	M100:	MOV A,R0 ;MI bit trans.
0386 3D	458		MOVD P3,A ;
	459		;
	460		;
0387 D40F	461		CALL TSET05 ;1 bit time counter set & start.
	462		;
0389 B95D	463		MOV R0,0TXBUF ;A[---[TXBUF]
038B F0	464		MOV A,0R0 ;
038C 67	465		RRC A ;Rotate right.
038D AB	466		MOV R3,A ;
038E F6C4	467		JC VLF01 ;Cy=1 ?
	468		;
03C0 D414	469		CALL VLF00 ;((Carry = 0)
	470		Transmissive data = '0' set.
	471		;
03C2 64C8	472		JMP M100E ;
	473		;
03C4 D429	474	VLF01:	CALL PALAN ;((Carry = 1)
	475		Parity analyse.
	476		;
03C6 D418	477		CALL VLF01 ;Transmissive data = '1' set.
	478		;
03C8 BA07	479	M100E:	MOV R2,007H ;Bit counter set.
	480		;
03CA 231F	481		MOV A,031 ;***NEXT [SNLING]*** ← 全更部分
03CC C4EF	482		JMP JMPR ;RETR.
	483		;
	484		;
	485		;
	486		;
	487		;
	488		( LIFE SAMPLE. )
	489		;
	490		;
	491		;
	492		;
03CE 00	493	SNLING:	NOP ;exist the bad Device on
03CF 36D9	494		JTO SMLOK ; this cable ?
	495		;
03D1 D40F	496		CALL TSET05 ;(Error !)
	497		Half bit time counter set &
	498		start.
03D3 FE	499		MOV A,R6 ;
03D4 4310	500		ORL A,010H ;
03D6 AE	501		MOV R6,A ;
03D7 64DF	502		JMP DWBOJP ;
	503	SMLOK:	CALL TSET05 ;(Ok !)
03D9 D40F	504		Half bit time counter set &
	505		start.
03DB FE	506		MOV A,R6 ;
03DC 53EF	507		ANL A,00EFH ;
03DE AE	508		MOV R6,A ;
	509	DWBOJP:	MOV A,01 ;***NEXT [DWBO]***
03DF 2301	510		JMP JMPR ;RETR.
03E1 C4EF	511		;
	512		;
	513		;

FILE: AK1:SHIG1

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

514 ;
515 ;           ( 8 BIT DATA Tx. )
516 ;
517 ;-----
518 ;
519 ;
03E3 F8      520 DWB0:  MOV    A,R0      ;Transmissive data trans.
03E4 3D      521        MOVD    P5,A      ;
522 ;
523 ;
03E5 D40B    524        CALL    TSET1      ;1 bit time counter set & start.
525 ;
03E7 FB      526        MOV    A,R3      ;Rotate right.
03E8 67      527        RRC    A      ;
03E9 AB      528        MOV    R3,A      ;
03EA F6F0    529        JC     VLFD2      ;CV = 1 ?
530 ;
03EC D414    531        CALL    VLFD0      ;Next transmissive data = '0' set.
532 ;
03EE 64F4    533        JMP     DWB0C      ;
534 ;
03F0 D429    535 VLFD2:  CALL    PALAN      ;Next transmissive data = '1' set.
536 ;
03F2 D41B    537        CALL    VLFD1      ;Parity flag set.
538 ;
03F4 EAFA    539 DWB0C:  DJNZ    R2,DWB0E      ;Transmissive data end ?
540 ;
03F6 2303    541        MOV    A,#3      ; ( end ! )
03F8 C4EF    542        JMP     JMPR      ;***NEXT [PALAN]***
543 ;
544 ;
03FA 2301    545 DWB0E:  MOV    A,#1      ; ( not end ! )
03FC C4EF    546        JMP     JMPR      ;***NEXT [DWB0]***
547 ;
548 ;
549 ;
550 ;-----
551 ;
552 ;           ( LAST DATA Tx. )
553 ;
554 ;-----
555 ;
556 ;
03FE F8      557 PALB0:  MOV    A,R0      ;Last data trans.
03FF 3D      558        MOVD    P5,A      ;
559 ;
560 ;
0400 D40B    561        CALL    TSET1      ;1 bit time counter set & start.
562 ;
0402 8869    563        MOV    R0,#ANSPAP      ;
0404 F0      564        MOV    A,00C      ;Parity flag check.
0405 120B    565        JB0     EVNST      ;
566 ;
0407 D414    567        CALL    VLFD0      ; ( Even ! )
568 ;
0409 840D    569        JMP     PBSED      ;Parity bit "0" set.
570 ;

```

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

040B D41B      571 EVNST:  CALL    VLFO1      ;( Odd ' )
               572 ;                      Parity bit "1" set.
               573 ;
040D 2305      574 PBSED:  MOV     A,#5       ;***NEXT [MTHINT]***
040F C4EF      575         JMP     JMPR      ;PETR.
               576 ;
               577 ;
               578 ;
               579 ;-----
               580 ;
               581 ;                      ( STOP BIT Tx. )
               582 ;
               583 ;-----
               584 ;
               585 ;
0411 F8        586 STOP0:  MOV     A,R0
0412 3D        587         MOVD    P5,A      ;Stop bit trans.
               588 ;
               589 ;
0413 D40F      590         CALL    TSET05      ;Half bit time counter set & start.
               591 ;
0415 8868      592         MOV     R0,@LAV1    ;Indirect addressing.
0417 F0        593         MOV     A,@R0      ;***NEXT (-- [LAV1]***
0418 C4EF      594         JMP     JMPR      ;RETR.
               595 ;
               596 ;
               597 ;
               598 ;-----
               599 ;
               600 ;                      ( PARITY BIT Tx. )
               601 ;
               602 ;-----
               603 ;
               604 ;
041A F8        605 PARBT:  MOV     A,R0
041B 3D        606         MOVD    P5,A      ;Parity bit trans.
               607 ;
               608 ;
041C D40F      609         CALL    TSET05      ;Half bit time counter set & start.
               610 ;
041E 2308      611         MOV     A,#8       ;Indirect addressing.
               612 ;                      ***NEXT [RCK]***
0420 C4EF      613         JMP     JMPR      ;RETR.
               614 ;
               615 ;
               616 ;
               617 ;-----
               618 ;
               619 ;
               620 ;                      ( RCK CHECK. )
               621 ;
               622 ;-----
               623 ;
               624 ;
0422 00        625 RCK:    NOP
0423 362D      626         JTO     SPCEI      ;RCK bit detect.
               627 ;

```

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
0425 D40F	628 ;	629	CALL TSET05 ;Half bit time counter set & start.
0427 FE	630 ;	631	MOV A,R6 ;RCK flag set.
0428 4340	632	ORL A,#40H ;( OK ! )	
042A AE	633	MOV R6,A ;	
042B 8433	634	JMP RCKE ;	
042D D40F	635 ;	636 SPCE1: CALL TSET05 ;Half bit time counter set & start.	
042F FE	637 ;	638 MOV A,R6 ;RCK flag set.	
0430 53BF	639	ANL A,#0BFH ;	
0432 AE	640	MOV R6,A ;	
0433 D41B	641 ;	642 RCKE: CALL VLF01 ;Stop bit "1" set.	
0435 2306	643 ;	644 MOV A,#6 ;***NEXT [STOP0]***	
0437 C4EF	645	JMP JMPR ;RETR.	
	646 ;		
	647 ;		
	648 ;		
	649 ;		
	650 ;		
	651 ;	( ACK CHECK. )	
	652 ;		
	653 ;		
	654 ;		
0439 00	655 ;		
043A 2647	656 ACK1: NOP ;		
	657	JNT0 CMCHK4 ;ACK bit detect.	
	658 ;		
043C D40F	659 ;	660 CALL TSET05 ;Half bit time counter set & start.	
043E FE	661 ;	662 MOV A,R6 ;RCK flag check	
043F D26A	663	JB6 RCKEND ;	
	664 ;		
0441 B4FF	665 ERRCKT: CALL BCNTBC ;( RCK error ! )		
0443 F28C	666	JB7 DP04ST ;	
0445 C4AF	667	JMP DISEND ;(EP)	
	668 ;		
0447 D40F	669 CMCHK4: CALL TSET05 ;Half bit time counter set & start		
0449 FE	670	MOV A,R6 ;	
044A 924E	671	JB4 ABERSP ;	
044C 8441	672	JMP ERRCKT ;	
	673 ;		
044E 8867	674 ABERSP: MOV R0,#DEMAPH ;make error message (04).		
0450 F0	675	MOV A,R0 ;	
0451 5307	676	ANL A,#07H ;	
0453 E7	677	RL A ;	
0454 E7	678	RL A ;	
0455 E7	679	RL A ;	
0456 A9	680	MOV R1,A ;	
0457 8837	681	MOV R6,#DRMAPH ;	
0459 F0	682	MOV A,R0 ;	
045A 5307	683	ANL A,#07H ;	
045C 49	684	ORL A,R1 ;	

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
045D B856	685	MOV	R0,#REB4H
045F A0	686	MOV	R0,A
0460 B858	687	MOV	R0,#REB4C
0462 B004	688	MOV	R0,#04H
0464 B857	689	MOV	R0,#REB4I
0466 B000	690	MOV	R0,#0H
0468 8441	691	JMP	ERRCKT
	692 ;		
	693 ;		
046A D422	694	RCKEND: CALL	PARCLL ;Parity flag clear
	695 ;		& VLF flags clear.
	696 ;		
046C B867	697	MOV	R0,#DENAPH ;Make address byte of 84 command.
046E F0	698	MOV	A,R0
046F 5307	699	ANL	A,#07H ;[#POLING] (--- drop number ( upper
0471 E7	700	RL	A ; 5 bit ) + device address ( lower
0472 E7	701	RL	A ; 3 bit ).
0473 E7	702	RL	A
0474 A9	703	MOV	R1,A
0475 B837	704	MOV	R0,#DRMAPH
0477 F0	705	MOV	A,R0
0478 5307	706	ANL	A,#07H
047A 49	707	ORL	A,R1
047B B86A	708	MOV	R0,#POLING
047D A0	709	MOV	R0,A
	710 ;		
047E B868	711	MOV	R0,#LAYI
0480 B000	712	MOV	R0,#0H ;84 command flag set.
0482 B868	713	MOV	R0,#CNTBY ;Byte counter clear.
0484 B000	714	MOV	R0,#0H
	715 ;		
0486 D414	716	CALL	VLF00 ;Start bit "0" set. test
	717 ;		
0488 2308	718	MOV	A,#11 ;(Advance )
	719 ;		***NEXT [KEYDAY]***
048A C4EF	720	JMP	JMPR ;RETR.
	721 ;		
048C E459	722	DP04ST: JMP	INT04S ;Disposal of 04 command.
	723 ;		
	724 ;		
	725 ;		
	726 ;		
	727 ;		
	728 ;		84COM-84COM-84COM-84COM-84COM-84COM-84COM-84COM
	729 ;		
	730 ;		DISPOSAL OF 84 COMMAND.
	731 ;		
	732 ;		84COM-84COM-84COM-84COM-84COM-84COM-84COM-84COM
	733 ;		
	734 ;		
	735 ;		
	736 ;		( START BIT Tx (--- Rx ROUTINE. )
	737 ;		8C11
	738 ;		
	739 ;		
	740 ;		
048E FB	741	KEYDAY: MOV	A,R0

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT	CODE	LINE	SOURCE LINE
048F 3D			742	MOVD PS,A ;Start bit trans.
			743 ;	
			744	
0490 D40B			745	CALL TSET1 ;1 bit time counter set & start.
			746 ;	
0492 D41B			747	CALL VLF01 ;Start bit reset stb "1" set.
			748 ;	
0494 230D			749	MOV A,#13 ;***NEXT [RSTAT]***
0496 C4EF			750	JMP JMPR ;RETR.
			751 ;	
			752 ;	
			753 ;	
			754 ;	
			755 ;	
			756 ;	( START BIT ERASE. --- Rx ROUTINE. )
			757 ;	
			758 ;	#C13
			759 ;	
			760 ;	
0498 FB			761	RSTAT: MOV A,R0 ;Start bit clear.
0499 3D			762	MOVD PS,A ;
			763 ;	
			764 ;	
049A D40F			765	CALL TSET05 ;Half bit time counter set & start.
			766 ;	
049C BA0B			767	MOV R2,#08H ;Bit counter set.
			768 ;	
049E 230E			769	MOV A,#14 ;***NEXT [RBSET]***
04A0 C4EF			770	JMP JMPR ;RETR.
			771 ;	
			772 ;	
			773 ;	
			774 ;	
			775 ;	
			776 ;	( DATA Rx --- Rx ROUTINE. )
			777 ;	
			778 ;	#C14
			779 ;	
			780 ;	
04A2 00			781	RBSET: NOP
04A3 26AB			782	JNTO VDAT11 ;Received data is
			783 ;	" 0 " or " 1 " ?
			784 ;	
			785 ;	
04A5 D40B			786	CALL TSET1 ;1 bit time counter set & start.
			787 ;	
04A7 F431			788	CALL VLF10 ; Data = "0". )
04A9 84B1			789	JMP CNTDN ;
			790 ;	( Data = "1". )
04AB D40B			791	VDAT11: CALL TSET1 ;1 bit time counter set & start.
			792 ;	
04AD D429			793	CALL PALAN ;Parity flag set.
04AF F42B			794	CALL VLF11 ;
			795 ;	
04B1 EAB7			796	CNTDN: DJNZ R2,SETRB ;Receive end or not ?
			797 ;	
			798 ;	( Receive end )

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT	CODE	LINE	SOURCE LINE
04A3 230C			799	PALKS: MOV A,#12
04B5 C4EF			800	JMP JMPR
			801 ;	
			802 ;	
04B7 230E			803	SETPB: MOV A,#14
04B9 C4EF			804	JMP JMPR
			805 ;	
			806 ;	
			807 ;	
			808 ;	
			809 ;	
			810 ;	( PARITY BIT Rx. --- Rx ROUTINE. )
			811 ;	
			812 ;	
			813 ;	
			814 ;	
04BB 00			815	PALK: NOP
04BC 26D5			816	JNT0 PTYBI
			817 ;	
			818 ;	
			819	CALL TSET05
04BE D40F			820 ;	
04C0 B869			821	MOV R0,#ANSPAR
04C2 F0			822	MOV A,0R0
04C3 12C7			823	JBO NCKAC
04C5 84CD			824	JMP ACKAC
			825 ;	
04C7 D41B			826	NCKAC: CALL VLF01
			827 ;	
			828 ;	
			829	MOV A,#17
04C9 2311			830	JMP JMPR
04CB C4EF			831 ;	
			832 ;	
04CD D424			833	ACKAC: CALL PARCLR
04CF D414			834	CALL VLF00
			835 ;	
			836 ;	
04D1 230F			837	MOV A,#15
04D3 C4EF			838	JMP JMPR
			839 ;	
04D5 D40F			840	PTYBI: CALL TSET05
			841 ;	
			842	MOV R0,#ANSPAR
04D7 B869			843	MOV A,0R0
04D9 F0			844	JBO ACKAC
04DA 12CD			845	JMP NCKAC
04DC 84C7			846 ;	
			847 ;	
			848 ;	
			849 ;	
			850 ;	
			851 ;	( ACK Tx. --- Rx ROUTINE. )
			852 ;	
			853 ;	
			854 ;	
			855 ;	

FILE: AKI:SHIGI

Hewlett-Packard: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
04DE F8	856	ACKOT:	MOV A,R0 ;ACK trans.
04DF 3D	857		MOVD P5,A ;
	858		;
	859		;
04E0 D40F	860		CALL TSET05 ;Half bit time counter set & start.
	861		;
04E2 FF	862		MOV A,R7 ;
04E3 4380	863		ORL A,#80H ;Response flag set.
04E5 AF	864		MOV R7,A ;
	865		;
04E6 D41B	866		CALL VLF01 ;Stop bit "1" set.
	867		;
04E8 231A	868		MOV A,#26 ;***NEXT [LCIN]***
04EA C4EF	869		JMP JMPR ;RETF.
	870		;
	871		;
	872		;
	873		;
	874		( STOP BIT Tx 1. CHALLENGE Rx ONCE MORE. )
	875		;
	876		;
	877		;
	878		;
04EC F8	879	REPRX:	MOV A,R0 ;Stop bit Tx.
04ED 3D	880		MOVD P5,A ;
	881		;
	882		;
04EE D40B	883		CALL TSET1 ;1 bit time counter set & start.
	884		;
04F0 D424	885		CALL PARCLR ;Parity flag clear.
	886		;
04F2 D414	887		CALL VLF00 ;Start bit "0" set.
	888		;
04F4 230B	889		MOV A,#11 ;***NEXT [KEYDAY]***
04F6 C4EF	890		JMP JMPR ;RETR.
	891		;
	892		;
	893		;
	894		;
	895		;
	896		( STOP BIT Tx 2. --- FOR 04 COMMAND. )
	897		;
	898		;
	899		;
	900		;
04F8 F8	901	STEP04:	MOV A,R0 ;Stop bit trans.
04F9 3D	902		MOVD P5,A ;
	903		;
	904		;
04FA D40B	905		CALL TSET1 ;1 bit time counter set & start.
	906		;
04FC B827	907		MOV R0,#SDMSGC ;
04FE B002	908		OR0,#02H ;Error indicator set.
0500 B826	909		MOV R0,#SDMSG1 ;
0502 B000	910		MOV OR0,#0H ;
	911		;
0504 E48A	912		JMP R04ERS ;



FILE: AKIISHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

913 ;
914 ;
915 ;
916 ;-----
917 ;
918 ;      ( STOP BIT Tx 3. FOR 84 COMMAND. )
919 ;
920 ;-----
921 ;
922 ;
0506 F8 923 STGR84: MOV     A,R0      ;Stop bit trans.
0507 3D 924 MOVD    P5,A        ;
925 ;
926 ;
0508 D40B 927 CALL    TSET1        ;1 bit time counter set & start.
928 ;
050A B85A 929 MOV     R0,#POLING      ;Drop & device address set
930 ;                      to response buffer.
050C F0 931 MOV     A,R0            ;
050D B856 932 MOV     R0,#RE84H      ;
050F A0 933 MOV     @R0,A          ;
934 ;
0510 B858 935 MOV     R0,#RE84C        ;
0512 B002 936 MOV     @R0,#02H        ;(( DEVICE to ECU link error ! )
0514 B857 937 MOV     R0,#RE84I      ;Error indicator set.
0516 B000 938 MOV     @R0,#0H        ;
0518 C4AF 939 JMP     DISEND          ;
940 ;
941 ;
942 ;
943 ;-----SUB ROUTINE-----
944 ;
945 ;      [ INPUT DATA SET TO 84 BUF. & BYTE COUNTER INC.ROUTINE. ]
946 ;
947 ;-----
948 ;
051A D403 949 INDBY: CALL    CNTBCK      ;
051C 0328 950 ADD     A,#SDMSGC+1      ;
051E A8 951 MOV     R0,A            ;
051F FB 952 MOV     A,R3            ;
0520 A0 953 MOV     @R0,A          ;Input data set to 84 buf.
954 ;
0521 D407 955 CALL    BCNINC          ;Byte counter inc.
0523 83 956 RET
957 ;
958 ;
959 ;-----
960 ;
961 ;      ( STOP BIT Tx 4. 84 COMMAND ALL OK ! END ! )
962 ;
963 ;-----
964 ;
965 ;
0524 F8 966 STGR84: MOV     A,R0      ;Stop bit trans.
0525 3D 967 MOVD    P5,A        ;
968 ;
969 ;

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FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE	
0526 D40B	970	CALL	TSET1	:1 bit time counter set & start.
	971 ;			
052B B827	972	MOV	R0,#SDMSGC	:Device address clear.
052A F0	973	MOV	A,QR0	:
052B 53F8	974	ANL	A,#0F8H	:
052D 77	975	RR	A	:
052E 77	976	RR	A	:
052F 77	977	RR	A	:
0530 A0	978	MOV	QR0,A	:
	979 ;			
0531 B41A	980	CALL	INDABY	:Input data set to 04 buf.
	981 ;			& byte counter inc.routine.
	982 ;			
0533 10	983	INC	QR0	:
	984 ;			
0534 F0	985	MOV	A,QR0	:
0535 B826	986	MOV	R0,#SDMSG1	:Byte counter buffer set.
0537 A0	987	MOV	QR0,A	:
	988 ;			
0538 E48A	989	JMP	R04ERS	
	990 ;			
	991 ;			
	992 ;			
	993 ;			
	994 ;			
	995 ;		( NCK Tx. --- Rx ROUTINE. )	
	996 ;			#C17
	997 ;			
	998 ;			
	999 ;			
053A F8	1000	NCKDT: MOV	A,R0	:NCK trans.
053B 3D	1001	MOVD	P5,A	:
	1002 ;			
	1003 ;			
053C D40B	1004	CALL	TSET1	:1 bit time counter set & start.
	1005 ;			
053E FE	1006	MOV	A,R6	:
053F 5248	1007	J82	REPER	:Error = 5 times ?
0541 1E	1008	INC	R6	:Error counter inc.
0542 D41B	1009	CALL	VLF01	:
	1010 ;			Stop bit "1" set.
	1011 ;			
0544 2319	1012	MOV	A,#25	:***NEXT [REPRX]***
0546 C4EF	1013	JMP	JMPR	:PETR.
	1014 ;			
0548 B868	1015	REPER: MOV	R0,#LAV1	: 5 times error ! )
054A F0	1016	MOV	A,QR0	:Disposal of 04 command or
	1017 ;			04 command ?
054B C653	1018	JZ	JER84	:
054D D41B	1019	CALL	VLF01	:04 command error response.
	1020 ;			stop bit "1" set.
	1021 ;			
054F 2316	1022	MOV	A,#22	:***NEXT [STER04]***
0551 C4EF	1023	JMP	JMPR	:RETR.
	1024 ;			
0553 D41B	1025	JER84: CALL	VLF01	:84 ( dr polling ) error response.
	1026 ;			stop bit "1" set.

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
		1027 ;	
0555 2315		1028 MOV A,#21	***NEXT [STEP04]***
0557 C4EF		1029 JMP JMPF	;PETP.
		1030 ;	
		1031 ;	
		1032 ;	
		1033 ;	
		1034 ;	( LAST CHARACTER INDICATOR CHECK. )
		1035 ;	#D26
		1036 ;	
		1037 ;	
		1038 ;	
0559 00		1039 LCIN: NOP	
055A 267B		1040 JNT0 LCIEH	;Last character indicator detect.
		1041 ;	
		1042 ;	
		1043 ;	
055C D40F		1044 CALL TSET05	;Half bit time counter set & start.
		1045 ;	
055E B868		1046 MOV R0,#LAV1	
0560 F0		1047 MOV A,#R0	
0561 C66F		1048 JZ BA104	;Disposal of 84 command or
		1049 ;	
0563 D403		1050 CALL CNTBCK	;Byte counter check.
0565 D304		1051 XRL A,#4H	;Data <= 5 byte ?
0567 C68E		1052 JZ LCIEH	;( 04 )error.
		1053 ;	good !
0569 D41B		1054 CALL VLF01	;( Disposal of 84 command ! )
		1055 ;	Stop bit "1" set.
		1056 ;	
056B 2312		1057 MOV A,#18	***NEXT [STGN04]***
056D C4EF		1058 JMP JMPR	;RETR.
		1059 ;	
056F D403		1060 BA104: CALL CNTBCK	
0571 D304		1061 XRL A,#4H	;Data <= 5 byte ?
0573 C694		1062 JZ DY04	;( 84 )error.
		1063 ;	
		1064 ;	good !
0575 D41B		1065 CALL VLF01	;( Disposal of 84 command ! )
		1066 ;	Stop bit "1" set.
		1067 ;	
0577 2310		1068 MOV A,#16	***NEXT [STGN84]***
0579 C4EF		1069 JMP JMPR	;PETR.
		1070 ;	
057B D40F		1071 LCIEH: CALL TSET05	;Half bit time counter set & start.
		1072 ;	
057D B868		1073 MOV R0,#LAV1	
057F F0		1074 MOV A,#R0	
0580 C688		1075 JZ ENST04	
0582 D41B		1076 CALL VLF01	;( Disposal of 84 command ! )
		1077 ;	Stop bit "1" set.
		1078 ;	
0584 2318		1079 MOV A,#24	***NEXT [STGR04]***
0586 C4EF		1080 JMP JMPR	;PETR.
		1081 ;	
		1082 ;	( Disposal of 84 command ! )
0588 D41B		1083 ENST04: CALL VLF01	

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT	CODE	LINE	SOURCE LINE
			1084 ;	Stop bit "1" set.
			1085 ;	
058A 2317		MOV	A,#23	;***NEXT [STGR84]***
058C C4EF		JMP	JMPR	;RETR.
			1088 ;	
			1089 ;	( grater than 5 byte! )
058E D41B	LCIER:	CALL	VLFO1	:( Disposal of 84 command ! )
			1091 ;	Stop bit "1" set.
			1092 ;	
0590 2316		MOV	A,#22	;***NEXT [STER04]***
0592 C4EF		JMP	JMPR	;RETR.
			1095 ;	
0594 D41B	DY84:	CALL	VLFO1	:( Disposal of 84 command ! )
			1097 ;	Stop bit "1" set.
			1098 ;	
0596 2315		MOV	A,#21	;***NEXT [STER34]***
0598 C4EF		JMP	JMPR	;RETR.
			1101 ;	
			1102 ;	
			1103 ;	
			1104 ;	-----
			1105 ;	
			1106 ;	( STOP BIT Tx 5. 84 COMMANMD ALL OK ! END ! )
			1107 ;	#D23
			1108 ;	-----
			1109 ;	
			1110 ;	-----
059A F8	STGR84:	MOV	A,R0	;Stop bit trans.
059B 3D		MOVD	P5,A	;
			1113 ;	-----
			1114 ;	
059C D40B		CALL	TSET1	;1 bit time counter set & start.
			1116 ;	
059E B4CC		CALL	RED5TB	;Response data set to 84 buffer.
			1118 ;	
05A0 B86A		MOV	R0,#POLING	;Disposal address buffer set.
05A2 F0		MOV	A,0R0	;
05A3 B856		MOV	R0,#RE34H	;
05A5 A0		MOV	0R0,A	;
05A6 D407		CALL	BCHINC	;Byte counter buffer set.
05A8 F0		MOV	A,0R0	;
05A9 B857		MOV	R0,#RE841	;
05AB A0		MOV	0R0,A	;
05AC C4AF		JMP	DISEND	;
			1128 ;	
			1129 ;	
			1130 ;	
			1131 ;	-----
			1132 ;	
			1133 ;	( STOP BIT Tx 6. 84 COMMAND Rx DATA CONTINUE. )
			1134 ;	#C16
			1135 ;	-----
			1136 ;	
			1137 ;	-----
05AE F8	STGR84:	MOV	A,R0	;Stop bit trans.
05AF 3D		MOVD	P5,A	;
			1140 ;	-----

FILE: AK1:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
		1141 ;	
0580 D40B		1142	CALL TSET1 ;1 bit time counter set & start.
		1143 ;	
0582 B4CC		1144	CALL REDSTB ;Input data set to 84 command
		1145 ;	buffer.
0584 D407		1146	CALL BCNINC ;Byte counter inc.
		1147 ;	
0586 D422		1148	CALL PARCLL ;Parity flag clear
		1149 ;	& VLF flags clear.
		1150 ;	
0588 D414		1151	CALL VLF00 ;
		1152 ;	Start bit "0" set.
		1153 ;	
058A 230B		1154	MOV A,#11 ;***NEXT [KEY/DAY]***
058C C4EF		1155	JMP JMPR ;RETR.
		1156 ;	
		1157 ;	
		1158 ;	
		1159 ;	-----
		1160 ;	
		1161 ;	( STOP BIT Tx 7. 04 COMMAND DATA Rx CONTINUE. )
		1162 ;	
		1163 ;	-----
		1164 ;	
		1165 ;	-----
058E FB	STGN04:	1166	MOV A,R0 ;Stop bit trans.
058F 3D		1167	MOVD P5,A ;
		1168 ;	-----
		1169 ;	
05C0 D40B		1170	CALL TSET1 ;1 bit time counter set & start.
		1171 ;	
05C2 B41A		1172	CALL INDABY ;Input data set to 04 buf.
		1173 ;	byte counter inc. routine.
		1174 ;	
05C4 D422		1175	CALL PARCLL ;Parity flag clear
		1176 ;	& VLF flags clear.
		1177 ;	
05C6 D414		1178	CALL VLF00 ;
		1179 ;	Start bit "0" set.
		1180 ;	
05C8 230B		1181	MOV A,#11 ;***NEXT [KEY/DAY]***
05CA C4EF		1182	JMP JMPR ;RETP.
		1183 ;	
		1184 ;	
		1185 ;	-----
		1186 ;	-----SUB ROUTINE-----
		1187 ;	
		1188 ;	
		1189 ;	[ RESPONSE DATA SET TO 84 BUFFER. ]
		1190 ;	
		1191 ;	-----
		1192 ;	
05CC D403	REDSTB:	1193	CALL CNTBCK ;
05CE 0358		1194	ADD A,#RE84C ;
05D0 A8		1195	MOV R0,A ;
05D1 FB		1196	MOV A,R3 ;
05D2 A0		1197	MOV GR0,A ;Input data set to 84 buf.

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
05D3 83		1198	RET
		1199 ;	
		1200 ;	
		1201 ;	
		1202 ;	
		1203 ;**** 04COM-04COM-04COM-04COM-04COM-04COM-04COM-04COM ****	
		1204 ;*	
		1205 ;*	DISPOSAL OF 04 COMMAND.
		1206 ;*	
		1207 ;**** 04COM-04COM-04COM-04COM-04COM-04COM-04COM-04COM ****	
		1208 ;	
		1209 ;	
		1210 ;	
		1211 ;	( START BIT Tx. (--- 04 COMMAND. )
		1212 ;	WD20
		1213 ;	
		1214 ;	
		1215 ;	
05D4 F8		1216 COM04:	MOV A,R0 ;Start bit trans.
05D5 3D		1217	MOVD P5,A
		1218 ;	
		1219 ;	
05D6 D40B		1220	CALL TSET1 ;1 bit time counter set & start.
		1221 ;	
05D8 8927		1222	MOV R0,#SDMSGC
05DA F0		1223	MOV A,R0
05DB B85D		1224	MOV R0,#TXBUF ;Tx buffer (--- command (04)
05DD A0		1225	MOV R0,A
05DE B868		1226	MOV R0,#LAV1
05E0 B013		1227	MOV R0,#19 ;[LAV1] <-- ACK3.
05E2 D414		1228	CALL VLF00 ;MI bit "0" set.
		1229 ;	
05E4 2302		1230	MOV A,#2 ;***NEXT (MI00)***
05E6 C4EF		1231	JMP JMPR ;PETR.
		1232 ;	
		1233 ;	
		1234 ;	
		1235 ;	
		1236 ;	
		1237 ;	( 04 COMMAND DATA Tx. )
		1238 ;	WE10
		1239 ;	
		1240 ;	
		1241 ;	
05E8 F8		1242 COM04D:	MOV A,R0 ;Start bit Tx.
05E9 3D		1243	MOVD P5,A
		1244 ;	
		1245 ;	
05EA D40B		1246	CALL TSET1 ;1 bit time counter set & start.
		1247 ;	
05EC D403		1248	CALL CNTBCK
05EE 0327		1249	ADD A,#SDMSGC
05F0 A8		1250	MOV R0,A
05F1 F0		1251	MOV A,R0
05F2 B85D		1252	MOV R0,#TXBUF ;Tx buffer (--- Data set.
05F4 A0		1253	MOV R0,A
05F5 B868		1254	MOV R0,#LAV1

FILE: AKI:SHIGI

HEWLETT-PACKARD: 804B Assembler

LOCATION	OBJECT	CODE	LINE	SOURCE	LINE
05F7 B009			1255	MOV	R0,09 ;[LAV1] ---- ACK4.
05F9 D41B			1256	CALL	VLFO1 ;M bit "1" set.
			1257 ;		
05FB 2302			1258	MOV	A,02 ;---NEXT (M100)---
05FD C4EF			1259	JMP	JMPR ;RETR.
			1260 ;		
			1261 ;		
			1262 ;		
			1263 ;		-----SUB ROUTINE-----
			1264 ;		
			1265 ;		
			1266 ;		[ BYTE COUNT BYTE CHECK. ]
			1267 ;		
			1268 ;		
			1269 ;		
05FF B826			1270	BCNTBC: MOV	R0,0SDMSG1 ;
0601 F0			1271	MOV	A,R0 ;
0602 83			1272	RET	
			1273 ;		
			1274 ;		
			1275 ;		-----SUB ROUTINE-----
			1276 ;		
			1277 ;		[ BYTE COUNTER CHECK. ]
			1278 ;		
			1279 ;		
			1280 ;		
0603 B86B			1281	CNTBCK: MOV	R0,0CNTBY ;
0605 F0			1282	MOV	A,R0 ;
0606 83			1283	RET	
			1284 ;		
			1285 ;		
			1286 ;		-----SUB ROUTINE-----
			1287 ;		
			1288 ;		[ BYTE COUNTER INC. ]
			1289 ;		
			1290 ;		
			1291 ;		
0607 B86B			1292	BCNINC: MOV	R0,0CNTBY ;
0609 10			1293	INC	R0 ;
060A 83			1294	RET	
			1295 ;		
			1296 ;		
			1297 ;		-----SUB ROUTINE-----
			1298 ;		
			1299 ;		[ 1 BIT TIME COUNTER SET. ]
			1300 ;		
			1301 ;		
			1302 ;		
060B 23EF			1303	TSET1: MOV	A,0239 ;
060D C411			1304	JMP	TIST ;
			1305 ;		
			1306 ;		
			1307 ;		-----SUB ROUTINE-----
			1308 ;		
			1309 ;		[ HALF BIT TIME COUNTER SET. ]
			1310 ;		
			1311 ;		

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

1312 ;
1313 TSET05: MOV    A,#248      ;
1314 ;
0611 62      1315 TIST:  MOV    T,A      ;
0612 45      1316      STRT  CNT      ;
0613 83      1317      RET              ;
1318 ;
1319 ;
1320 -----SUB ROUTINE-----
1321 ;
1322 ;           [ VLF OUTPUT DATA "0" SET. ]
1323 ;
1324 -----
1325 ;
0614 8837    1326 VLF00:  MOV    R0,#DRMAPH ;
0616 F0      1327      MOV    A,0R0      ;
0617 5307    1328      ANL    A,#07H      ;
0619 C420    1329      JMP    VLF0ST    ;
1330 ;
1331 ;
1332 -----SUB ROUTINE-----
1333 ;
1334 ;           [ VLF OUTPUT DATA "1" SET. ]
1335 ;
1336 -----
1337 ;
061B 8837    1338 VLF01:  MOV    R0,#DRMAPH ;
061D F0      1339      MOV    A,0R0      ;
061E 4308    1340      ORL    A,#08H      ;
0620 A8      1341 VLF0ST: MOV    R0,A      ;
0621 83      1342      RET              ;
1343 ;
1344 ;
1345 -----SUB ROUTINE-----
1346 ;
1347 ;           [ PARITY FLAG CLEAR. ]
1348 ;
1349 -----
1350 ;
0622 8E00    1351 PARCLL: MOV    R6,#0      :VLF flags clear.
1352 ;
0624 8869    1353 PARCLP: MOV    R0,#ANSPAR :Parity flag clear.
0626 8000    1354      MOV    0R0,#0H      ;
0628 83      1355      RET              ;
1356 ;
1357 ;
1358 -----SUB ROUTINE-----
1359 ;
1360 ;           [ PARITY CHECK. ]
1361 ;
1362 -----
1363 ;
0629 8869    1364 PALANI: MOV    R0,#ANSPAR ;
062B 10      1365      INC    0R0      ;
062C 83      1366      RET              ;
1367 ;
1368 ;

```



FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

1369 ;-----SUB ROUTINE-----
1370 ;
1371 ;      [ Error response set to 04 buffer. ]
1372 ;
1373 ;-----
1374 ;
062D B827 1375 ERRSES: MOV    R0,#SDMSGC ;Error indicate .
062F FE    1376        MOV    A,R6 ;
0630 D236 1377        JB6     ERRSEA ;
0632 B003 1378        MOV    @R0,#03H ;( abnormal error ! )
0634 C438 1379        JMP     ERRSEE ;
1380 ;
0636 B001 1381 ERRSEA: MOV    @R0,#01H ;( normal error ! )
0638 B826 1382 ERRSEE: MOV    R0,#SDMSG1 ;
063A B000 1383        MOV    @R0,#0H ;
063C E48A 1384        JMP     R04ERS ;
1385 ;
1386 ;
1387 ;-----
1388 ;
1389 ;      ( ACK CHECK 3 <--- 04 COMMAND. )
1390 ;
1391 ;-----#029
1392 ;
1393 ;
063E 00    1394 ACK3:  NOP ;
063F 2648 1395        JNT0    ACKER ;ACK bit Rx.
1396 ;
1397 ;
-0641 D40F 1398        CALL    TSET05 ;Half bit time counter set & start.
1399 ;
0643 FE    1400        MOV    A,R6 ;RCK ?
0644 D254 1401        JB6     ACKSSC ;
0646 C44A 1402        JMP     ACKER2 ;
1403 ;
0648 D40F 1404 ACKER:  CALL    TSET05 ;Half bit time counter set & start.
1405 ;
064A FE    1406 ACKER2: MOV    A,R6 ;
064B 527D 1407        JB2     ACEND ;5 times error ?
064D 1E    1408        INC     R6 ;
064E D414 1409        CALL    VLF00 ;Re-challenge.
1410 ;      Start bit "0".set.
1411 ;
0650 2314 1412        MOV    A,#20 ;***NEXT (COM04)***
0652 C4EF 1413        JMP     JMPR ;RETR.
1414 ;
0654 B824 1415 ACKSSC: MOV    R0,#SDMSGK ;:(command only!)
0656 F0    1416        MOV    A,@R0 ;
0657 325F 1417        JB1     RUMOD ;
0659 B826 1418        MOV    R0,#SDMSG1 ;
065B B040 1419        MOV    @R0,#01000000B;
065D E48A 1420        JMP     R04ERS ;
1421 ;
065F 126D 1422 RUMOD:  JB0     RDMOD ;Command + RD or WR ?
0661 B868 1423        MOV    R0,#CNTBY ;
0663 B001 1424        MOV    @R0,#1H ;
0665 D422 1425        CALL    PARCLL ;Parity flag clear

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FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
		1426 ;	
0667 D414		1427 ;	CALL VLF00 ; & VLF flags clear.
		1428 ;	Start bit "0" set.
		1429 ;	
		1430 ;	(command + message!)
0669 230A		1431 ;	***NEXT (COM04D)***
066B C4EF		1432 ;	;RETR.
		1433 ;	
066D D422		1434 RDMOD: CALL	PARCLL ;Parity flag clear
		1435 ;	& VLF flags clear.
066F B86B		1436 ;	
0671 B001		1437 ;	
0673 B86B		1438 ;	
0675 B000		1439 ;	
0677 D414		1440 ;	CALL VLF00 ;Start bit "0" set.
		1441 ;	
		1442 ;	(command + response!)
0679 230B		1443 ;	***NEXT [KEYDAY]***
067B C4EF		1444 ;	;RETR.
		1445 ;	
067D C42D		1446 ACEND: JMP	ERRSES ;
		1447 ;	
		1448 ;	
		1449 ;	
		1450 ;	-----
		1451 ;	
		1452 ;	( ACK CHECK 4. /--- 04 COMMAND. )
		1453 ;	
		1454 ;	----- #B9
		1455 ;	
		1456 ;	
067F 00		1457 ACK4: NOP	
0680 2689		1458 ;	JNT0 AERCK ;ACK bit check.
		1459 ;	-----
		1460 ;	
0682 D40F		1461 ;	CALL TSET05 ;Half bit time counter set & start.
		1462 ;	
0684 FE		1463 ;	MOV A,R6 ;(ACK !)
0685 D293		1464 ;	JB6 AOKCK ;
0687 C48B		1465 ;	JMP AERCK2 ;
		1466 ;	
		1467 ;	
0689 D40F		1468 AERCK: CALL	TSET05 ;( NCK ! )
		1469 ;	;Half bit time counter set & start.
068B FE		1470 AERCK2: MOV	A,R6 ;5 times error ?
068C 52A7		1471 ;	JB2 AENCK ;
068E 1E		1472 ;	INC R6 ;Error counter Inc.
		1473 ;	Challenge once more.
068F D424		1474 ;	CALL PARCLR ;Parity flag clear.
0691 C4A1		1475 ;	JMP A04CON ;
		1476 ;	
0693 B4FF		1477 AOKCK: CALL	BCNTBC ;( ACK & PCK ok ! )
0695 5307		1478 ;	ANL A,#07H ;
0697 A9		1479 ;	MOV R1,A ;
0698 C9		1480 ;	DEC R1 ;
0699 D403		1481 ;	CALL CNTBCK ;
069B D9		1482 ;	XRL A,R1 ;

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE	
069C C6A9	1483	JZ	END04W	;Tx operation end or not ?
069E 10	1484	INC	0R0	;
069F D424	1485	CALL	PARCLR	;Parity flag clear.
	1486 ;			
	1487 ;			
	1488 ;			( Tx operation continue
				for 04 com ! )
06A1 D414	1489 A04CON:	CALL	VLF00	;Start bit "0" set.
	1490 ;			
06A3 230A	1491	MOV	A,010	;***NEXT (COM04D)***
06A5 C4EF	1492	JMP	JMPR	;RETR.
	1493 ;			
06A7 C42D	1494 AENCK:	JMP	ERRSES	;04 command response error.
	1495 ;			Error indicator set.
	1496 ;			
	1497 ;			( Tx operation end for 04 com ! )
06A9 B826	1498 END04W:	MOV	R0,#SDMSG1	;
06AB B040	1499	MOV	0R0,#01000000B;	
06AD E48A	1500	JMP	R04ERS	;
	1501 ;			
	1502 ;			
	1503 ;			
	1504 ;			-----SUB ROUTINE-----
	1505 ;			
	1506 ;			
	1507 ;			[ JMP TO HEAD ROUTINE. ]
	1508 ;			
	1509 ;			-----
06AF D422	1511 DISEND:	CALL	PARCLL	;Parity flag clear
	1512 ;			& VLF flags clear.
06B1 B837	1513	MOV	R0,#RE841	
06B3 F0	1514	MOV	A,0R0	
06B4 F2BA	1515	JB7	JPIDL	
06B6 231B	1516	MOV	A,#27	
06B8 C4EF	1517	JMP	JMPR	
	1518 ;			
06BA FF	1519 JPIDL:	MOV	A,R7	;Response flags check
06BB F2CA	1520	JB7	PCHK5	;
	1521 ;			
	1522 ;			( no response ! )
06BD B867	1523 CONTDE:	MOV	R0,#DEMAPH	;Device end
06BF F0	1524	MOV	A,0R0	;
06C0 F2C5	1525	JB7	ALEND	;
06C2 1D	1526	INC	R5	
06C3 6477	1527	JMP	DMSRE	;Device continue.
	1528 ;			
	1529 ;			
06C5 FF	1530 ALEND:	MOV	A,R7	;
06C6 D2E8	1531	JB6	PRDR2	;
06C8 C4F2	1532	JMP	NTDRP	;
	1533 ;			
	1534 ;			( response ! )
06CA 537F	1535 PCHK5:	ANL	A,#7FH	;
06CC AF	1536	MOV	R7,A	;Response flag clear.
	1537 ;			
06CD 92E4	1538	JB4	PRDEV	;
	1539 ;			

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
06CF B867	1540	MOV	R0,#DEMAPH ;
06D1 F0	1541	MOV	A,R0 ;
06D2 F2DF	1542	JB7	QUESE ;
06D4 FF	1543	MOV	A,R7 ;
06D5 B2D9	1544	JB5	PRLSFS ;
	1545 ;		
06D7 C4BD	1546	JMP	CONTDE ;
	1547 ;		
06D9 FF	1548	PRLSFS: MOV	A,R7 ;
06DA 4340	1549	ORL	A,#040H ;
06DC AF	1550	MOV	R7,A ;
06DD C4BD	1551	JMP	CONTDE ;
	1552 ;		
06DF FF	1553	QUESE: MOV	A,R7 ;
06E0 B2EB	1554	JB5	PRDRP ;
06E2 C4BD	1555	JMP	CONTDE ; P.R.device poll &
	1556 ;		R.R.drop poll. )
06E4 B2EB	1557	PRDEV: JB5	PRDR2 ; Priority device poll
	1558 ;		& P.R.drop poll. )
06E6 C4F2	1559	JMP	NTDRP ;Next drop select.
	1560 ;		
06E8 53BF	1561	PRDR2: ANL	A,#0BFH ;
06EA AF	1562	MOV	R7,A ;
	1563 ;		
06EB BD5E	1564	PRDRP: MOV	R5,#DEMAP0 ;
06ED C4FC	1565	JMP	STDPS ; Priority or R.R.device poll
	1566 ;		& priority drop poll. )
	1567 ;		1st drop select.
	1568 ;		
	1569 ;		-----SUB ROUTINE----
	1570 ;		
	1571 ;		[ RETURN ROUTINE. ]
	1572 ;		
	1573 ;		-----
06EF C5	1575	JMPR: SEL	R0 ;
06F0 2F	1576	XCH	A,R7 ;
06F1 93	1577	RETR	
	1578 ;		
	1579 ;		
	1580 ;		-----SUB ROUTINE----
	1581 ;		
	1582 ;		[ NEXT ACCESS DROP SELECT. ]
	1583 ;		
	1584 ;		-----
	1585 ;		
	1586 ;		
06F2 BD5E	1587	NTDRP: MOV	R5,#DEMAP0 ;
06F4 FC	1588	MOV	A,R4 ;
06F5 A8	1589	MOV	R0,A ;
06F6 F0	1590	MOV	A,R0 ;
06F7 F2FC	1591	JB7	STDPS ;Drop end or not ?
06F9 1C	1592	INC	R4 ; not end ! )
	1593 ;		Next drop set.
06FA E409	1594	JMP	SETSD ;
	1595 ;		
	1596 ;		

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION	OBJECT CODE	LINE	SOURCE LINE
06FC BC31	1597	STDPS:	MOV R4,#DRMAP0 ; Drop end ! )
06FE B831	1598		MOV R0,#DRMAP0 ;
0700 F0	1599		MOV A,R0 ;
0701 7205	1600	JB3	SELSET ;Drop map set or not ?
	1601	;	
0703 E409	1602	JMP	SETSD
	1603	;	
	1604	;	Not set ! )
0705 2304	1605	SELSET:	MOV A,#4 ;***NEXT [MTMINT]***
0707 C4EF	1606	JMP	JMPR ;RETR.
	1607	;	
0709 FC	1608	SETSD:	MOV A,P4 ;( Set ! )
070A A8	1609		MOV R0,A ;
070B F0	1610		MOV A,R0 ;
	1611	;	
070C 4308	1612	ANSWD:	ORL A,#08H ;
070E A8	1613		MOV R0,A ;
	1614	;	
070F FF	1615		MOV A,R7 ;
0710 3216	1616	JB1	DSCF84 ;
	1617	;	
0712 231C	1618		MOV A,#28 ;***NEXT [DSCF84]***
0714 C4EF	1619	JMP	JMPR ;RETR.
	1620	;	
	1621	;	
	1622	;	
	1623	;	
	1624	;	
	1625	;	[ DROP SCAN FOR 84 COMMAND. ]
	1626	;	
	1627	;	
	1628	;	
	1629	;	
0716 F8	1630	DSCF84:	MOV A,R0 ;Drop scan.
0717 3D	1631		MOVD P5,A ;
	1632	;	
	1633	;	
0718 FF	1634		MOV A,R7 ;
0719 321D	1635	JB1	DSCFJJ ;
	1636	;	
071B D40B	1637	CALL	TSET1 ;1 bit time counter set.
	1638	;	
071D FF	1639	DSCFJJ:	MOV A,R7 ;Response flag 2 clear.
071E 53FD	1640		ANL A,#0FDH ;
0720 AF	1641		MOV R7,A ;
	1642	;	
0721 F8	1643		MOV A,R0 ;
0722 5387	1644		ANL A,#087H ;
0724 B837	1645		MOV R0,#DRMAPH ;
0726 A0	1646		MOV R0,A ;
	1647	;	
0727 2304	1648		MOV A,#4 ;***NEXT [MTMINT]***
0729 C4EF	1649	JMP	JMPR ;RETR.
	1650	;	
	1651	;	
	1652	;	
	1653	;	SUB ROUTINE---

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE

SOURCE LINE

```

1634 ;
1635 ;           [ VLF INPUT DATA " 1 " SET. ]
1636 ;
1637 ;-----
1638 ;
072B 97      1639 VLF11:  CLR    C           ;
072C A7      1640          CPL    C           ;
1641 ;
072D FB      1642 VLF11:  MOV    A,R3          ;
072E 67      1643          RRC    A           ;
072F AB      1644          MOV    R3,A        ;
0730 83      1645          RET             ;
1646 ;
1647 ;
1648 ;-----
1649 ;-----SUB ROUTINE-----
1650 ;
1651 ;           [ VLF INPUT DATA " 0 " SET. ]
1652 ;
1653 ;-----
1654 ;
0731 97      1655 VLF10:  CLR    C           ;
0732 E42D    1656          JMP    VLF11          ;
1657 ;
1658 ;
1659 ;-----
1660 ;
1661 ;           ( WAIT for 84 COMMAND DISPOSAL. )
1662 ;
1663 ;-----
1664 ;
0734 D40F    1665 IDLINT:  CALL   TSET05          ;Half bit time counter set & start.
0736 B857    1666          MOV    R0,#RE841      ;84 buffer empty.
0738 F0      1667          MOV    A,R0           ;
0739 F243    1668          JB7     DNTSET          ;
1669 ;
1670 ;
073B B4FF    1671          CALL   BCNTBC          ;Exit 04 operation.
073D F245    1672          JB7     ST04DP          ;
1673 ;
073F 231B    1674          MOV    A,#27          ;***NEXT [IDLINT]***
0741 C4EF    1675          JMP     JMFR           ;
1676 ;
0743 C4BA    1677 DNTSET:  JMP     JPIDL          ;84 buffer empty.
1678 ;
1679 ;
1680 ;
0745 FF      1681 ST04DP:  MOV    A,R7           ;
0746 4301    1682          ORL    A,#01H          ;
0748 AF      1683          MOV    R7,A           ;
0749 E459    1684          JMP    INT04S          ;
1685 ;
1686 ;-----
1687 ;
1688 ;           [ CHANGING OPERATION TO 84 . ]
1689 ;
1690 ;-----
1691 ;

```

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FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

1711 ;
1712 ;
1713 ; .....
0748 F8 1714 NDPS04: MOV A,R0 ;
074C 3D 1715 MOVD P5,A ;
1716 ; .....
1717 ;
1718 ; CALL TSET1 ; 1 bit timer counter set & start.
074D D40B 1719 ;
1720 ;
074F FF 1720 MADAD2: MOV A,R7 ;
0750 1254 1721 JB0 ARIWT ;
0752 C4AF 1722 JMP DISEND ;
0754 53FE 1723 ARIWT: ANL A,#0FEH ;
0756 AF 1724 MOV R7,A ;
0757 E434 1725 JMP IDLINT ;
1726 ;
1727 ; -----SUB ROUTINE-----
1728 ;
1729 ; [ 04 DPOP SELECT. ]
1730 ;
1731 ; -----
1732 ;
0759 B825 1733 INT04S: MOV P0,#SDMSGH ;
075B F0 1734 MOV A,0R0 ;
075C 5307 1735 ANL A,#07H ;
075E A9 1736 MOV R1,A ;
075F B837 1737 MOV R0,#DRMAPH ;
0761 F0 1738 MOV A,0R0 ;
0762 5307 1739 ANL A,#07H ;
0764 D9 1740 XRL A,R1 ;
0765 C67B 1741 JZ NOCHGE ;
1742 ;
0767 F9 1743 MOV A,R1 ;
0768 4308 1744 ORL A,#08H ;
076A A8 1745 MOV R0,A ;
1746 ;
076B FF 1747 MOV A,R7 ;
076C 3272 1748 JB1 DSF04B ;
1749 ;
076E 231D 1750 MOV A,#29 ; ***NEXT [DSF04C]***
0770 C4EF 1751 JMP JMFR ; RETP.
1752 ;
0772 53FD 1753 DSF04B: ANL A,#0FDH ;
0774 AF 1754 MOV R7,A ;
0775 E477 1755 JMP DSF04C ;
1756 ;
1757 ;
1758 ; -----
1759 ; .....
1760 ;
1761 ; [ DROP SCAN FOR 04 COMMAND. ]
1762 ;
1763 ; .....
1764 ;
1765 ;
0777 F8 1766 DSF04C: MOV A,R0 ;
0778 3D 1767 MOVD P5,A ;

```

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE SOURCE LINE

```

1768 ; .....
1769 ;
0779 D40B 1770 CALL TSET1 ;1 bit time counter set.
1771 ;
0778 F9 1772 NOCHGE: MOV A,R1 ;
077C B837 1773 MOV R0,#DRMAPH ;
077E 20 1774 XCH A,R0 ;
077F B86C 1775 MOV R0,#SAVDRP ;
0781 A0 1776 MOV @R0,A ;
1777 ;
1778 ;
0782 D422 1779 CALL PARCLL ;Parity flag clear
1780 ; % VLF flags clear.
0784 D414 1781 CALL VLF00 ;Start "0" bit set.
1782 ;
0786 2314 1783 MOV A,#20 ;***NEXT [COM04]***
0788 C4EF 1784 JMP JMPR ;RETF.
1785 ;
1786 ;
1787 ;-----SUB ROUTINE-----
1788 ;
1789 ; [ 04 COMMAND DISP END. ]
1790 ;
1791 ;-----
1792 ;
078A B86C 1793 R04ERS: MOV R0,#SAVDRP ;
078C F0 1794 MOV A,@R0 ;
078D B937 1795 MOV R1,#DRMAPH ;
078F 21 1796 XCH A,@R1 ;
0790 A8 1797 MOV R0,A ;
1798 ;
0791 FF 1799 MOV A,R7 ;
0792 52A7 1800 JB2 TSUGIN ;
1801 ;
0794 F1 1802 MOV A,@R1 ;
0795 D8 1803 XRL A,R0 ;
0796 C6AE 1804 JZ MADADE ;
1805 ;
0798 B867 1806 MOV R0,#DEMAPH ;
079A F0 1807 MOV A,@R0 ;
079B F2AC 1808 JB7 TSUGI2 ;
1809 ;
079D F1 1810 MOV A,@R1 ;
079E 5307 1811 ANL A,#07H ;
07A0 4308 1812 ORL A,#08H ;
07A2 A8 1813 MOV R0,A ;
07A3 231E 1814 MOV A,#30 ;
07A5 C4EF 1815 JMP JMPR ;
1816 ;
07A7 53FB 1817 TSUGIN: ANL A,#0FBH ;
07A9 AF 1818 MOV R7,A ;
1819 ;
07AA C4F2 1820 JMP NTDRP ;
07AC C4AF 1821 TSUGI2: JMP DISEND ;
1822 ;
07AE E44F 1823 MADADE: JMP MADAD2 ;
1824 ;

```



FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

LOCATION OBJECT CODE LINE

SOURCE LINE

```

1825 ;
1826 ;-----SUB ROUTINE-----
1827 ;
1828 ;      [ CHANGING THE DEVICE MAP. ]
1829 ;
1830 ;-----
1831 ;
1832 ;
1833 ;.....
1834 ;      HEAD ADDRESS TABLE OF THE DEVICE MAP 1.
1835 ;.....
1836 ;
1837 ROMTI: DB      DVM10      ;Drop #0 ( device map 1 ).
1838 ;
1839 DB      DVM11      ;Drop #1 (      "      ).
1840 ;
1841 DB      DVM12      ;Drop #2 (      "      ).
1842 ;
1843 DB      DVM13      ;Drop #3 (      "      ).
1844 ;
1845 DB      DVM14      ;Drop #4 (      "      ).
1846 ;
1847 DB      DVM15      ;Drop #5 (      "      ).
1848 ;
1849 ;.....
1850 ;
1851 DEVCH: MOV      R0,#DRMAPH ;Device table head address set.
1852      MOV      A,R0        ;      for current drop #. )
1853      ANL      A,#07H      ;
1854      ADD      A,#ROMTI     ;
1855      MOVP     A,A         ;
1856 ;
1857      MOV      R1,A         ;
1858      MOV      A,R1         ;
1859      JB3      PUEND        ;Device polling map set or not
1860      MOV      A,R1         ;Priority or round robin ?
1861      ADD      A,#04H       ;
1862      MOV      R0,A         ;
1863      MOV      A,R0         ;
1864      JB3      PRSET        ;
1865      MOV      A,R7         ;Polling flag set (round robin.)
1866      ANL      A,#0EFH     ;
1867      JMF      RPSETE       ;
1868 ;
1869 PRSET: MOV      A,R7         ;Polling flag set (priority poll.)
1870      ORL      A,#10H       ;
1871 RPSETE: MOV      R7,A         ;
1872 ;
1873      MOV      R0,#DEMAP0    ;R0 = device map 2 pointer.
1874      MOV      R2,#00H       ;R2 = F.F flag.
1875 ;
1876 DEVPS: MOV      A,R2         ;
1877      JNZ      SWPAC         ;
1878      MOV      R2,#0FFH      ;
1879      MOV      A,R1         ;< bit 0 - 3 >
1880      JMP      CONCT         ;
1881 ;

```

FILE: AKI:SHIGI

HEWLETT-PACKARD: 8048 Assembler

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LOCATION	OBJECT	CODE	LINE	SOURCE	LINE
07DE BA00	1892	SWPAC:	MOV	R2,#0H	; bit 4 - 7
07E0 F1	1893		MOV	A,R1	
07E1 47	1894		SWAP	A	
07E2 19	1895		INC	R1	
	1896				
07E3 530F	1897	CONCT:	ANL	A,#0FH	;map 2 --- map 1.
07E5 A0	1898		MOV	R0,A	
07E6 D30F	1899		XRL	A,#0FH	
07E8 C6F2	1890		JZ	DEVCE	;Device end ?
07EA F8	1891		MOV	A,R0	
07EB D365	1892		XRL	A,#DEMAP?	;Device map end ?
07ED C6F3	1893		JZ	DEVCE2	
07EF 18	1894		INC	R0	
07F0 E4D6	1895		JMP	DEVPS	
	1896				
07F2 C8	1897	DEVCE:	DEC	R0	
07F3 F0	1898	DEVCE2:	MOV	A,R0	
07F4 4380	1899		ORL	A,#80H	
07F6 A0	1900		MOV	R0,A	
07F7 83	1901		RET		
	1902				
07F8 885E	1903	PUEND:	MOV	R0,#DEMAP0	;Device map 1 not set.
07FA 80FF	1904		MOV	R0,#0FFH	
07FC 83	1905		RET		
	1906				
	1907				
	1908				

1908 ;\*\*\*\*\* END \*\*\*\*\*

Errors= 0

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## SOURCE LINE

```

1 0000
2 ;
3 ;*****
4 ;
5 SEISAKU_UC: EQU 01H ;
6 SEISAKU_MM: EQU 12H ;
7 SEISAKU_YY: EQU 58H ;
8 SEISAKU_VV: EQU 2 ; Version No.
9 ;****
10 ;**** <<< TOSHINO_OS >>>
11 ;**** <<< TOSHIBA NO OS >>>
12 ;**** <<< TOSHI & INO OS >>>
13 ;**** <<< TOSHI NO OS >>>
14 ;****
15 ;**** <<< Data Format
16 ;**** Adrs H --- ( ECU Address H )
17 ;**** Adrs L --- ( ECU Address L )
18 ;**** Data Length N
19 ;**** Data 1
20 ;****
21 ;**** ( Data F to Drop P Command / Data )
22 ;****
23 ;**** Data N
24 ;**** ----- By M.TANAKA & T.INOUE -----
25 ;****
26 ;****
27 ;**** Function
28 ;****
29 ;**** (1) --- CCC & ECU Communication
30 ;**** Echo Back
31 ;**** Forced Tuning / Off / Key
32 ;**** Send Function ( ALORA ) Test
33 ;****
34 ;**** (2) --- Ram Back up
35 ;****
36 ;**** (3) --- Verification
37 ;****
38 ;****
39 ;****
40 ;****
41 ;*****
42 ;*****
43 ;***** <<< Bug List >>>
44 ;*****
45 ;*****
46 ;*****
47 ;*****
48 ;*****
49 ;*****
50 ;
51 ;
52 BIAS: EQU 0000H
53 ;
54 ;
55 PROGRAMVERSION: EQU BIAS ; DS 4
56 PR_CRC_ERROR: EQU BIAS+4 ; DS 4
57 RX_CRC_OK_YO: EQU BIAS+8 ; DS 4

```

## APPENDIX C

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

58 IBF_OVER_FLOW: EQU BIAS+12          ; DS 2
59 SCAN_MODE_FLAG: EQU BIAS+14          ; DS 1
60 VIEW_CHANNEL: EQU BIAS+16            ; DS 8*2
61 PC_CODE: EQU BIAS+32                 ; DS 8*2
62 EVENT_CHANNEL EQU BIAS+48            ; DS 8
63 ; EQU BIAS+56
64 VLF_ERROR_MAP: EQU BIAS+128           ; DS 128
65 PC_FC_LIST: EQU BIAS+256              ; DS 128
66 BASIC_AUTHO: EQU BIAS+256+128         ; DS 128
67 ; BIAS+512
68
69
70
71 ;
72 A200H: EQU 200H
73 CH_NO_FREQ EQU A200H                  ; DS 256 FREQUENCY TABLE START FROM HEPI
74 TIME_TABLE: EQU A200H+100H           ; 8*8*2
75 JUMP_ADDRESS: EQU A200H+180H         ; 8*8*2
76 NEXT_GO_ADRS: EQU A200H+200H         ; 64*2
77 ; --- 480H
78 TO_DROP: EQU 0500H
79 TO_CCC: EQU 0600H
80 ;
81 DS2: EQU 0700H
82 INDEX_RX_1: EQU DS2+2*1
83 INDEX_TX_1: EQU DS2+2*2
84 CTRL_1: EQU DS2+2*3
85 CTRL_1_COUNT: EQU DS2+2*4
86 INDEX_RX_2: EQU DS2+2*5
87 INDEX_TX_2: EQU DS2+2*6
88 CTRL_2: EQU DS2+2*7
89 CTRL_2_COUNT: EQU DS2+2*8
90 PAGE_SW: EQU DS2+2*9
91 ECHO_BACK_FLAG: EQU DS2+2*10
92 REVERS_CHANNEL: EQU DS2+2*11
93 TX_BUSY_FLAG: EQU DS2+2*12
94 BASE_POINT: EQU DS2+2*13
95 INIT_POINT: EQU DS2+2*14
96 BINARY_LED: EQU DS2+2*15
97 ECHO_BACK_ADPS: EQU DS2+2*16
98
99 CONV_NO: EQU DS2+2*18
100 DROP_NO: EQU DS2+2*19
101 IC_BYTE: EQU DS2+2*20
102 DEVICE_NO: EQU DS2+2*21
103 ID_BYTE: EQU DS2+2*22
104 CONV_NO_BIT: EQU DS2+2*23
105 DROP_NO_BIT: EQU DS2+2*24
106 DEVICE_NO_BIT: EQU DS2+2*25
107
108 MUL_ADR EQU DS2+2*29 ; DS 2 STORE #3
109 EXTRN_STAT EQU DS2+2*30 ; DS 2
110 TEMP_R_CH EQU DS2+2*31 ; DS 2
111
112 ; 740H
113 OBF_BF_N: EQU DS2+2*32 ; 0000 0000
114 OBF_BF_CMD: EQU OBF_BF_N+1

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

115 OBF_BF_ID:      EQU OBF_BF_N+2
116 OBF_BF_BYTE:    EQU OBF_BF_N+3
117 CONV_SELECT:    EQU OBF_BF_N+16 : DS 2
118
119 ;
120 DS1:             EQU 0780H
121 NOW_EVENT:       EQU DS1
122 BEFOR_EVENT:     EQU DS1+1
123 EVENT_ENABLE:    EQU DS1+2
124
125 LSB_LED:         EQU DS1+4
126 MSB_LED:        EQU DS1+5
127 MSB_LED:        EQU DS1+6
128 PPV_LED:        EQU DS1+7
129
130 KEY_DATA:        EQU DS1+9
131 ONE_SEC_TIMER:   EQU DS1+10
132 TUNER_D1:        EQU DS1+11
133 TUNER_D2:        EQU DS1+12
134 TUNER_CBL:       EQU DS1+13
135 UP_FLAG:         EQU DS1+14
136 DOWN_FLAG:       EQU DS1+15
137 PC_FC_EXIST:    EQU DS1+16
138 POWER_FEED:     EQU DS1+17
139 ;
140
141
142 DS16:             EQU 800H
143 DROP_CMD_BF:     EQU DS16
144 SPU_CMD_BF:      EQU DS16+16*1
145 FROM_OBF_BF:     EQU DS16+16*2
146
147 SEND_ENABLE:      EQU DS16+16*3
148 SEND_ADDRESS:     EQU SEND_ENABLE+1
149 SEND_INDEX:       EQU SEND_ADDRESS+2
150 SEND_CMD_RESP:    EQU SEND_ADDRESS+3
151 SEND_DATA_BUFF:   EQU SEND_ADDRESS+4
152
153 EVENT_NO_FREQ:    EQU 900H
154
155
156
157 ;
158 ; -----
159 ;
160 KEY_DATA_STACK:   EQU 1000H
161 ECU_ADDRESS:      EQU KEY_DATA_STACK+16*64
162 TX_LENGTH:        EQU ECU_ADDRESS+2
163 TX_COMMAND:       EQU ECU_ADDRESS+3
164 TX_BUFFER:        EQU ECU_ADDRESS+4
165
166
167 ;
168 TIMER_COUNTER:    EQU 2000H-4
169 INDEX_HISTORY:    EQU 2000H-2
170 HISTORY_BUFFER:   EQU 2000H
171

```

: DS 16

: DS 16

: DS 16

: DS 1

: DS 2

: DS 1

: DS 1

: DS 123

: DS 256

: DS 16\*64=1024

: DS 2

: DS 1

: DS 1

: DS 256

HEWLETT-PACKARD: 8036 Assembler.

## SOURCE LINE

```

172
173
174 ;
175 PAGE_MEM:      EQU 3000H
176
177 STACK_END:      EQU 39FFH
178 STACK_TOP:      EQU 4000H
179 ;
180 ; ***** BACK_UP RAM Area *****
181 ;
182 ES_BACK_UP:      EQU 0           ; DS 512
183 ES_BACK_UP_1:    EQU 200H        ; DS 512
184 ES_BACK_UP_2:    EQU 400H        ; DS 512
185 ;
186 ES_EVENT_TIMER:  EQU 600H        ; DS 128*6
187
188 ;
189 ; ***** Immediate Data *****
190 ;
191 MUL_NO           EQU             3
192 TIMER_OUT_CODE: EQU 0
193 PLUS_KEY_CODE:   EQU 10H
194 EVENT_KEY_CODE:  EQU 11H
195 AUTHO_KEY_CODE:  EQU 12H
196 ONOFF_KEY_CODE: EQU 13H
197 MINUS_KEY_CODE:  EQU 14H
198 SCAN_KEY_CODE:   EQU 15H
199 CLEAR_KEY_CODE:  EQU 16H
200 SEND_KEY_CODE:   EQU 17H
201 POWER_ON_CODE:   EQU 18H
202 POWER_OFF_CODE:  EQU 19H
203 RECENT_ON_CODE:  EQU 1AH
204 RELEASE_CODE:    EQU 1BH
205 KEY_PUSH_CODE:   EQU 1CH
206 ;
207 ASCII_EP:        EQU 4572H
208 ASCII_AU:        EQU 4155H
209 ASCII_SC:        EQU 5343H
210 ASCII_FT:        EQU 4643H
211 ASCII_PC:        EQU 5043H
212 ASCII_CL:        EQU 434CH
213 ASCII_SE:        EQU 5345H
214 ASCII_AD:        EQU 4164H
215 ASCII_DE:        EQU 6445H
216 ASCII_MU:        EQU 0D49CH
217 ASCII_NO:        EQU 0D4DCH
218 ASCII_CO:        EQU 43DCH
219 ASCII_PR:        EQU 5072H
220 ;
221 PUSH_ALL:        EQU 60H
222 POP_ALL:         EQU 61H
223 ;
224 SEND_MAX:        EQU 64*2
225 ;
226 ; -----
227 ; ***** I / O Port *****
228 ; -----

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

229 ;
230 DROP_CMD_PORT: EQU 082H
231 DROP_DATA_PORT: EQU 090H
232 ECU_H_ADDRESS: EQU 0102H
233 ECU_L_ADDRESS: EQU 0100H
234 INT_OFST      EQU      0A0H+(5*4)
235 INT10FST      EQU      52
236 INT30FST      EQU      60
237 TIMER1_OFST   EQU      72
238 ACHD          EQU      00
239 ACHC          EQU      04
240 BCHD          EQU      02
241 BCHC          EQU      06
242
243
244
245
246 ;-----CS      SET-----
247 ;
248 ;             INITIAL SET UP IAPX186
249 ;
250 ;-----
251 ORG          0000H
252 RUN:        CLI
253             ;LCS SET UP      16KB
254             MOV              AX,0FFA2H
255             XCHG             DX,AX
256             MOV              AX,00F8H
257             OUT              DX,AX
258             ;PCS SET UP FROM 0000H AT I/O MAPPED
259             MOV              AX,0FFA4H
260             XCHG             DX,AX
261             MOV              AX,003FH
262             OUT              DX,AX
263             MOV              AX,0FFA8H
264             XCHG             DX,AX
265             MOV              AX,863CH
266             OUT              DX,AX
267             ;MCS SET UP 04000H
268             MOV              DX,0FFA6H
269             MOV              AX,21FCH
270             OUT              DX,AX
271 ;
272             MOV              AX,2000H
273             MOV              DS,AX
274 ;
275 ;
276 RAM_CLEAR:  MOV BX,BIAS
277             MOV AX,0
278 RAM_CLEAR_LP: MOV [BX],AX
279             ADD BX,2
280             CMP BX,4000H
281             JC RAM_CLEAR_LP
282 ;
283 ;
284 ;-----JUMP TABLE WRITE-----
285             MOV              AX,0

```

0000 FA

0001 B8A2FF

0004 92

0005 B8F800

0008 EF

0009 B8A4FF

000C 92

000D B83F00

0010 EF

0011 B8A8FF

0014 92

0015 B83C88

0018 EF

0019 B8A6FF

001C B8FC21

001F EF

0020 B80020

0023 8ED8

0025 B80000

0028 B80000

002B 8907

002D 83C302

0030 81FB0040

0034 72F5

0036 B80000

:3-WAITES INSERTED

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

0039 8ED8      286      MOV          DS,AX
                287 ;-----INT1 ADDR.-----
003B BB3400    288      MOV          BX,INT1OFST
003E C7070002  289      MOV          WORD PTR [BX],200H
0042 C7470200FE 290      MOV          WORD PTR [BX+2],0FE00H
                291 ;-----INT3 ADDR.-----
0047 BB3C00    292      MOV          BX,INT3OFST
004A C7070003  293      MOV          WORD PTR [BX],300H
004E C7470200FE 294      MOV          WORD PTR [BX+2],0FE00H
                295 ;-----INT0 ADDR. /CASCADDED WITH INT2/INTA0/-----
0053 BBB400    296      MOV          BX,INT_OFST
0056 C7070004  297      MOV          WORD PTR [BX],400H
005A C7470200FE 298      MOV          WORD PTR [BX+2],0FE00H
005F C747040003 299      MOV          WORD PTR [BX+4],300H
0064 C7470600FE 300      MOV          WORD PTR [BX+6],0FE00H
0069 C747080006 301      MOV          WORD PTR [BX+8],600H
006E C7470A00FE 302      MOV          WORD PTR [BX+10],0FE00H
                303 ;-----TIMER 1 INTR. ADDR.-----
0073 BB4800    304      MOV          BX,TIMER1_OFST
0076 C7070007  305      MOV          WORD PTR [BX],700H
007A C7470200FE 306      MOV          WORD PTR [BX+2],0FE00H
                307 ;-----SET UP TIMER-----
                308 ;
                309 ;
007F B80020    310      MOV          AX,2000H
0082 8ED8      311      MOV          DS,AX
0084 8ED0      312      MOV          SS,AX
                313 ;-----50KHz SQUARE WAVE-----
0086 BA52FF    314      MOV          DX,0FF52H
0089 B80F00    315      MOV          AX,15
008C EF        316      OUT          DX,AX
008D BA54FF    317      MOV          DX,0FF54H
0090 B80F00    318      MOV          AX,15
0093 EF        319      OUT          DX,AX
0094 BA56FF    320      MOV          DX,0FF56H
0097 B803C0    321      MOV          AX,0C003H
009A EF        322      OUT          DX,AX
                323 ;-----INITIAL SET UP OF DMA CH.0:RX TRANS---
                324 ;-----SOURCE POINTER-----
009B B80000    325      MOV          AX,ACHD
009E BAC0FF    326      MOV          DX,0FFC0H
00A1 EF        327      OUT          DX,AX
00A2 B000      328      MOV          AL,0
00A4 BAC2FF    329      MOV          DX,0FFC2H
00A7 EF        330      OUT          DX,AX
                331 ;-----INITIAL SET UP OF DMA CH.1:TX TRANS---
                332 ;-----DESTINATION POINTER-----
00AB B80000    333      MOV          AX,ACHD
00AB BAD4FF    334      MOV          DX,0FFD4H
00AE EF        335      OUT          DX,AX
00AF B000      336      MOV          AL,0
00B1 BAD6FF    337      MOV          DX,0FFD6H
00B4 EE        338      OUT          DX,AL
                339 ;-----STACK SET UP-----
00B5 BCF03F    340      MOV          SP,3FF0H
                341 ;-----INITIAL SET UP OF 8274-----
00B8 B018      342      MOV          AL,00011000B ;CH.RESET

```



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HEWLETT-PACKARD: 3086 Assembler

## SOURCE LINE

```

00BA E604      343      OUT          ACBC,AL
                344  ;--PTR 2A--
00BC 0B0231    345      MOV          BX,0011000100000010B
00BF 0A0400    346      MOV          DX,ACBC
00C2 E87E01    347      CALL         SETCOM
                348  ;--PTR 2B--
00C5 0B0228    349      MOV          BX,0010100000000010B
00C8 0A0600    350      MOV          DX,BCMC
00CB E87501    351      CALL         SETCOM
                352  ;--PTR 4A--
00CE 0B0420    353      MOV          BX,0010000000000100B
00D1 0A0400    354      MOV          DX,ACBC
00D4 E86C01    355      CALL         SETCOM
                356  ;--PTR 4B--
00D7 0B0420    357      MOV          BX,0010000000000100B
00DA 0A0600    358      MOV          DX,BCMC
00DD E86301    359      CALL         SETCOM
                360  ;--PTR 7A--
00E0 0B077E    361      MOV          BX,0111111000000111B
00E3 0A0400    362      MOV          DX,ACBC
00E6 E85A01    363      CALL         SETCOM
                364  ;--PTR 1B--
00E9 0B010C    365      MOV          BX,0000110000000001B
00EC 0A0600    366      MOV          DX,BCMC
00EF E85101    367      CALL         SETCOM
                368  ;-----RX INIT-----
00F2 0010      369      MOV          AL,00010000B
00F4 E604      370      OUT          ACBC,AL
                371  ;--PTR 1A--
00F6 0B012C    372      MOV          BX,0010110000000001B
00F9 0A0400    373      MOV          DX,ACBC
00FC E84401    374      CALL         SETCOM
                375  ;--PTR 5A--
00FF 0B05E2    376      MOV          BX,1110001000000101B
0102 0A0400    377      MOV          DX,ACBC
0105 E83B01    378      CALL         SETCOM
                379  ;--RTS OFF--
0108 0B05E2    380      MOV          BX,1110001000000101B
010B 0A0400    381      MOV          DX,ACBC
010E E83201    382      CALL         SETCOM
                383  ;-----INITIAL SET UP OF INT0,INT1,INT3,UNMASK-----
0111 0B2800    386      MOV          AX,28H          ;LEVEL=0,EDGE TRIGGER MASK,CASCADE
0114 0A38FF    387      MOV          DX,0FF38H
0117 EF        388      OUT          DX,AX
                389  ;--INT1--
0118 0B1A00    390      MOV          AX,1AH          ;LEVEL=1,LEVEL TRIGGER MASK
011B 0A3AFF    391      MOV          DX,0FF3AH
011E EF        392      OUT          DX,AX
                393  ;--INT3--
011F 0B1900    394      MOV          AX,19H          ;LEVEL=2,LEVEL TRIGGER MASK
0122 0A3EFF    395      MOV          DX,0FF3EH
0125 EF        396      OUT          DX,AX
                397  ;--TIMER1 INTR.--
0126 0B0B00    398      MOV          AX,1011B        ;LEVEL=3,MASK
0129 0A32FF    399      MOV          DX,0FF32H

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

012C EF	400	OUT	DX,AX
	401		
	402		
	403		
	404		
	405		
	406		
	407		
	408		
	409		
	410		
	411		
	412		
	413		
	414		
	415		
	416		
	417 ;		
	418 ;		
	419 ;		
	420 ;	Initialize	
	421 ;		
	422 ;		
	423 ;		
012D B80000	424	MAIN_START:	MOV AX,0
	425 ;		
0130 B80005	426		MOV BX,TO_DROP
0133 891E0207	427		MOV [INDEX_RX_1],BX
0137 891E0407	428		MOV [INDEX_TX_1],BX
0138 A23E07	429		MOV BYTE PTR [TEMP_R_CH],AL
013E A21807	430		MOV [TX_BUSY_FLAG],AL
0141 A22407	431		MOV [CONV_NO],AL
0144 A29107	432		MOV [POWER_FEED],AL
	433 ;		
0147 A35007	434		MOV [CONV_SELECT],AX
014A A35207	435		MOV [CONV_SELECT+2],AX
014D A35407	436		MOV [CONV_SELECT+4],AX
0150 A35607	437		MOV [CONV_SELECT+6],AX
	438 ;		
0153 B80006	439		MOV BX,TO_CCC
0156 891E0C07	440		MOV [INDEX_TX_2],BX
015A 891E0A07	441		MOV [INDEX_RX_2],BX
	442 ;		
015E A20607	443		MOV [CTRL_1],AL
0161 A20807	444		MOV [CTRL_1_COUNT],AL
0164 A20E07	445		MOV [CTRL_2],AL
0167 A24007	446		MOV [OBF_BF_N],AL
016A A31407	447		MOV [ECHO_BACK_FLAG],AX
016D A31607	448		MOV [REVERFS_CHANEL],AX
	449 ;		
0170 B80030	450		MOV AX,PAGE_MEM
0173 A31207	451		MOV [PAGE_SW],AX
	452 ;		
0176 B84107	453		MOV BX,OBF_BF_CMD
0179 891E1007	454		MOV [CTRL_2_COUNT],BX
	455 ;		
017D B00A	456		MOV AL,10

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

017F A28A07      457      MOV [ONE_SEC_TIMER],AL
                  458 ;
0182 B80020      459      MOV AX,HISTORY_BUFFER
0185 A3FE1F      460      MOV [INDEX_HISTORY],AX
0188 E88205      461      CALL ECU_AOPS_READ
                  462 ;
018B E8D605      463      CALL INIT_AUTHO_TBL      ;=
018E E8F305      464      CALL INIT_VIEW_TBL      ;=
0191 E84B06      465      CALL INIT_CODE      ;=
0194 B03F        466      MOV AL,3FH      ;=
0196 A20E00      467      MOV [SCAN_MODE_FLAG],AL      ;=
                  468
                  469
0199 E85606      470      CALL          FREQ_CALC
019C E8D306      471      CALL CHANNEL_HOSE1
019F E8FC05      472      CALL EVENT_DATA_CL
01A2 E89705      473      CALL INIT_EV_TIMER
                  474 ;
                  475 ;-----
                  476 ;
01A5 B80004      477      MOV BX,ES_BACK_UP_2
01A8 26813FA5A5  478      CMP WORD FIP ES:[BX],0A5A5H
01AD 740A        479      JZ BACK_UP_KAI
01AF B80002      480      MOV BX,ES_BACK_UP_1
01B2 26813FA5A5  481      CMP WORD FIP ES:[BX],0A5A5H
01B7 7542        482      JNZ BACK_UP_EXIT
01B9 8BF3        483 BACK_UP_KAI:  MOV SI,BX
01BB B8FC01      484      MOV AX,508
01BE B90000      485      MOV CX,0
01C1 26326F04    486 BACK_UP_CK1:  XOR CH,ES:[BX+4]
01C5 26024F04    487      ADD CL,ES:[BX+4]
01C9 43          488      INC BX
01CA 4B          489      DEC AX
01CB 75F4        490      JNZ BACK_UP_CK1
                  491 ;
01CD 263A6C02    492      CMP CH,ES:[SI+2]
01D1 7528        493      JNZ BACK_UP_EXIT
01D3 263A4C03    494      CMP CL,ES:[SI+3]
01D7 7521        495      JNZ BACK_UP_NONE
                  496 ;
01D9 8BDE        497 BACK_UP_YES:  MOV BX,SI
01DB 81F30002    498      XOR BX,ES_BACK_UP_1
01DF 81F30004    499      XOR BX,ES_BACK_UP_2
01E3 891EFC1F    500      MOV [TIMER_COUNTER],BX
                  501 ;
01E7 B80002      502      MOV AX,312
01EA B80000      503      MOV BX,PROGRAMVERSION
01ED 268A0C      504 BACK_UP_CK2:  MOV CL,ES:[SI]
01F0 880F        505      MOV [BX],CL
01F2 43          506      INC BX
01F3 46          507      INC SI
01F4 4B          508      DEC AX
01F5 75F6        509      JNZ BACK_UP_CK2
01F7 E90100      510      JMP BACK_UP_EXIT
                  511 ;
01FA 90          512 BACK_UP_NONE:  NOP
                  513 ;

```

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HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

01FB E81D05 514 BACK_UP_EXIT: CALL INIT_TIM_TBL ;
01FE E83D05 515 CALL INIT_JUMP_TBL ;
516 ;
0201 BE0000 517 MOV SI,PROGRAMVERSION
0204 C60458 518 MOV BYTE PTR [SI],SEISAKU_YY
0207 C6448112 519 MOV BYTE PTR [SI+1],SEISAKU_MM
0208 C6440201 520 MOV BYTE PTR [SI+2],SEISAKU_DD
020F C6440302 521 MOV BYTE PTR [SI+3],SEISAKU_VV
522 ;
523 ;-----
0213 B840A0 524 MOV AX,0A040H
0216 BACAFF 525 MOV DX,0FFCAH
0219 EF 526 OUT DX,AX
527 ;
528 ; IN AL,ACMC
529 ; AND AL,0101111B
021A B07F 529 MOV AL,0111111B
021C B83C07 530 MOV BX,EXTRN_STAT
021F 8807 531 MOV BYTE PTR [BX],AL
532 ;--UNMASK--INTR-----
0221 B84C00 533 MOV AX,01001100B ;NOW UNMASK INTO,INT1,INT2,TIMEP1_INTF
0224 BA28FF 534 MOV DX,0FF28H
0227 EF 535 OUT DX,AX
536 ;-----
537 ;-----RX. ENABLE-----
0228 B803D9 538 MOV BX,1101100100000011B
022B BA0400 539 MOV DX,ACMC
022E E81200 540 CALL SETCOM
541 ;-----MAIN INITIALIZE TIMER2-----
0231 B80008 542 MOV AX,00800H
0234 BA62FF 543 MOV DX,0FF62H
0237 EF 544 OUT DX,AX
0238 B801C0 545 MOV AX,1100000000000001B
023B BA66FF 546 MOV DX,0FF66H
023E EF 547 OUT DX,AX
548 ;-----
023F FB 549 STI
550 ;
0240 E9BD00 551 JMP HAJIMEPUYO
552
553
554
555
556
557
558 ;
559 ;-----
560 ;-----SETCOM for 8274-----
0243 8AC3 561 SETCOM: MOV AL,BL
0245 EE 562 OUT DX,AL
0246 8AC7 563 MOV AL,BH
0248 EE 564 OUT DX,AL
0249 C3 565 RET
566 ;-----
567 ;-----PTR 1A-----
024A B001 568 HDLC_TX_START: MOV AL,00000001B
024C E604 569 OUT ACNC,AL
024E B00F 570 MOV AL,00001111B

```

HEWLETT-PACKARD: 9086 Assembler

## SOURCE LINE

```

0250 E604      571      OUT          ACHC,AL
                572 ;-----REVERSE CH.SELECT-----
0252 B005      573      MOV          AL,00000101B
0254 E604      574      OUT          ACHC,AL
0256 A01607     575      MOV          AL,BYTE PTR (REVERS_CHANEL)
0259 A23E07     576      MOV          BYTE PTR (TEMP_R_CH),AL
025C BAE0       577      MOV          AH,AL
025E 2401       578      AND          AL,00000001B
0260 F8         579      CLC
0261 D0C0       580      ROL          AL
0263 0C60       581      OR           AL,01100000B
0265 E604       582      OUT          ACHC,AL
0267 B005       583      MOV          AL,00000101B
0269 E606       584      OUT          BCNC,AL
026B BAC4       585      MOV          AL,AH
026D 2402       586      AND          AL,00000010B
026F 0CE0       587      OR           AL,11100000B
0271 E606       588      OUT          BCNC,AL
                589 ;-----PTR 5A-----
                590      MOV          AL,00000101B
                591      OUT          ACHC,AL
                592      MOV          AL,01100000B
                593      OUT          ACHC,AL
0273 E85300     594      CALL         WAIT          ;RTS HOLD 12ms UNTIL T.ENAPL
0276 E85000     595      CALL         WAIT
0279 E84D00     596      CALL         WAIT
027C E84A00     597      CALL         WAIT
027F E84700     598      CALL         WAIT
0282 E84400     599      CALL         WAIT
0285 E84100     600      CALL         WAIT
0288 E83E00     601      CALL         WAIT
                602 ;-----PTR 5A-----
028B B005       603      MOV          AL,00000101B
028D E604       604      OUT          ACHC,AL
028F A03E07     605      MOV          AL,BYTE PTR (TEMP_R_CH)
0292 2401       606      AND          AL,00000001B
0294 F8         607      CLC
0295 D0C0       608      ROL          AL
0297 0C69       609      OR           AL,01101001B
0299 E604       610      OUT          ACHC,AL
                611 ;-----RTS ON-----
                612
029B B080       613      MOV          AL,10000000B
029D E604       614      OUT          ACHC,AL
                615 ;-----INITIAL SET UP OF DMA,CH.1:TX TRANS-----
                616 ;-----SOURCE POINTER SET-----
                617 ;-----DESTINATION POINTER SET-----
029F B8C6       618      MOV          AX,S1          ;SOURCE ADR.
02A1 40         619      INC          AX
02A2 BAD0FF     620      MOV          DX,0FFD0H
02A5 EF         621      OUT          DX,AX
02A6 B002       622      MOV          AL,02H
02A8 BAD2FF     623      MOV          DX,0FFD2H
02AB EE         624      OUT          DX,AL
02AC BAC1       625      MOV          AL,CL          ;TRANSFER COUNT
02AE B400       626      MOV          AH,0
02B0 BAD8FF     627      MOV          DX,0FFD8H

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

02B3 EF      628      OUT          DX,AX
              629 ;-----TRANSFER COUNT-----
02B4 BADAFF  630 ;-----CONTROL WORD SET-----
              631      MOV          DX,OFFDAH
02B7 B8B616  632      MOV          AX,01686H
02BA EF      633      OUT          DX,AX          ;DMA GO !
              634 ;-----WAIT ROUTINE-----
02BB E80B00  635      CALL          WAIT
              636 ;-----FIRST BYTE OUTPUT-----
02BE 8BDE    637      MOV          BX,SI          ;SOURCE ADR.
02C0 8A07    638      MOV          AL,[BX]
02C2 E600    639      OUT          ACHD.AL
              640 ;
02C4 B0C0    641      MOV          AL,11000000B
02C6 E604    642      OUT          ACHC.AL
02C8 C3      643      RET
              644 ;=====WAIT=====
02C9 B80000  645 WAIT:      MOV          BX,0
02CC 43      646 WAIT1:   INC          BX
02CD 81FBFF00 647      CMP          BX,OFFH
02D1 75F9    648      JNE          WAIT1
02D3 C3      649      RET
              650
              651
              652
              653
              654
              655
              656
              657
              658
              659
              660
              661
              662
              663
              664
              665
              666
              667
              668
              669
              670
              671 ;-----INTR 3-----
              672      ORG          06300H
02D3 C3      673 ;000000      CLI
              674 ;
              675 ;-----
              676 ;***** OBF Interrupt Operation *****
              677 ;-----
              678 ;
0300 9C      679 OBF_INTERRUPT: PUSHF          ;PUSH ALL
0301 60      680      DB 60H
0302 E480    681      IN AL,DROP_DATA_PORT
              682 ;
0304 8B361007 683      MOV SI,[CTRL_2_COUNT]
0308 8904    684      MOV [SI],AL          ; Data Store

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

636A 44          685      INC SI
636B 89361007    686      MOV [CTRL_2_COUNT],SI      ; Pointer Increment
636C          687      ;
636D 8E4007     688      MOV SI,0BF_BF_H
636E FE064007   689      INC BYTE PTR [0BF_BF_H]      ; Data Length Increment
636F 8A0E4007   690      MOV CL,[0BF_BF_H]
6370 8A6401     691      MOV AH,[SI+1]      ; AH = Command Byte
6371          692      ;
6372 80F901     693      CMP CL,1
6373 730F       694      JNZ RESPONSE_2
6374 9001      695      MOV AL,1      ; 1 Byte Response
6375 80FC00     696      CMP AH,0      ; [ 00 ] [ 07 ]
6376 7429      697      JZ RESPONSE_CHK
6377 80FC07     698      CMP AH,7
6378 7424      699      JZ RESPONSE_CHK
6379 E90200     700      JMP OBF_RET
637A          701      ;
637B 80F902     702      RESPONSE_2:  CMP CL,2
637C 72F8      703      JC OBF_RET_1
637D          704      ;
637E 8002      705      MOV AL,2      ; 2 Byte Response
637F 80FC04     706      CMP AH,84H      ; [ 01 ] [ 02 ] [ 03 ] [ 05 ] [ 06 ] [ 08 ]
6380 7405      707      JZ RESPONSE_VAL      ; Valiable Length
6381 80FC04     708      CMP AH,4      ; [ 04 ] [ 04 ]
6382 7310      709      JNZ RESPONSE_CHK
6383          710      ;
6384 80F904     711      RESPONSE_VAL:  CMP CL,4      ; [ 04 ] [ 08 ] > 4
6385 726C      712      JC OBF_RET
6386 8A4403     713      MOV AL,[SI+3]      ; Byte Length Load
6387 8403      714      ADD AL,3
6388 3C03      715      CMP AL,3
6389 7302      716      JNZ RESPONSE_CHK
638A FE00      717      INC AL      ; [04][04] Error Response
638B          718      ;
638C 3AC0      719      RESPONSE_CHK:  CMP CL,AL
638D 725D      720      JC OBF_RET
638E          721      ;
638F 885401     722      OBF_PACKET:  MOV DX,[SI+1]
6390 80CA40     723      OR DL,40H      ; 8742 ----> 88166 Then OR 40H
6391 8B1EFE1F   724      MOV BX,[INDEX_HISTORY]
6392 8917      725      MOV [BX],DX
6393 885403     726      MOV DX,[SI+3]
6394 895702     727      MOV [BX+2],DX
6395 885405     728      MOV DX,[SI+5]
6396 895704     729      MOV [BX+4],DX
6397 8816FC1F   730      MOV DX,[TIMER_COUNTER]
6398 895706     731      MOV [BX+6],DX
6399 83C308     732      ADD BX,8
639A 81FB0030   733      CMP BX,PAGE_MEM
639B 7203      734      JC OBF_MEMO
639C 880020     735      MOV BX,HISTORY_BUFFER
639D 891EFE1F   736      MOV [INDEX_HISTORY],BX
639E          737      ;
639F 8A260E07   738      MOV AH,[CTRL_2]
63A0 80FC20     739      CMP AH,40
63A1 731C      740      JNC OBF_MEMO
63A2          741      ;

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

638E 8B1E0A07 742      MOV BX,[INDEX_RX_2]
6392 8B07 743      MOV [BX],AL
6394 FEC3 744      INC BL
6396 8A6401 745 RESPONSE_TRNS: MOV AH,[SI+1]
6399 8B27 746      MOV [BX],AH
639B 46 747      INC SI
639C FEC3 748      INC BL
639E FEC8 749      DEC AL
63A0 75F4 750      JNZ RESPONSE_TRNS
751 ;
63A2 FE060E07 752      INC BYTE PTR [CTRL_2]
63A6 891E0A07 753      MOV [INDEX_RX_2],BX
754 ;
63AA A24007 755 OBF_NEW: MOV [OBF_BF_M],AL ; [OBF_BF_M] = 0
63AD B84107 756      MOV AX,OBF_BF_CMD
63B0 A31007 757      MOV [CTRL_2_COUNT],AX ; [CTRL_2_COUNT] = OBF_BF_CMD
758 ;
63B3 B80F00 759 OBF_RET: MOV AX,15
63B6 BA22FF 760      MOV DX,0FF22H
63B9 EF 761      OUT DX,AX
63BA 61 762      DB 61H ;POP ALL
63BB 9D 763      POPF
63BC FB 764      STI
63BD CF 765      IRET
766 ;-----INTR 1-----
767      ORG 06200H
768 ;00000000 CLI
769 ;
770 ;-----
771 ;***** Drop Processor IBF Operation *****
772 ;-----
773 ;
6200 9C 774 IBF_INTERRUPT: PUSHF
6201 60 775      DB 60H
6202 8B1E0407 776      MOV BX,[INDEX_TX_1]
6206 8A0E0607 777      MOV CL,[CTRL_1]
620A 8A260807 778      MOV AH,[CTRL_1_COUNT]
620E 80FC00 779      CMP AH,0
6211 756C 780      JNZ IBF_2ND
781 ;
6213 80F900 782 IBF_1ST: CMP CL,0
6216 750A 783      JNZ IBF_EXIST
784 ;-----MASK IBF/ INTR.
6218 B81A00 785 IBF_EMPTY: MOV AX,1AH
621B BA3AFF 786      MOV DX,0FF3AH
621E EF 787      OUT DX,AX
621F E97500 788      JMP IBF_RET
789 ;
6222 8A27 790 IBF_EXIST: MOV AH,[BX]
6224 FEC3 791      INC BL
6226 8A07 792      MOV AL,[BX]
6228 E682 793      OUT DROP_CMD_PORT,AL
794 ;
622A FEC3 795      INC BL
622C 891E0407 796      MOV [INDEX_TX_1],BX
6230 FECC 797      DEC AH
6232 8B260807 798      MOV [CTRL_1_COUNT],AH

```



HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

6236 7506      799      JNZ IBF_PACKET
6238 FEC9      800      DEC CL
623A 880E0607  801      MOV [CTRL_1],CL
802 ;
623E 8B36FE1F  803 IBF_PACKET:  MOV SI,[INDEX_HISTORY]
6242 8804      804      MOV [SI],AL
6244 8A07      805      MOV AL,[BX]
6246 884401    806      MOV [SI+1],AL
6249 FEC3      807      INC BL
624B 8A07      808      MOV AL,[BX]
624D 884402    809      MOV [SI+2],AL
6250 FEC3      810      INC BL
6252 8A07      811      MOV AL,[BX]
6254 884403    812      MOV [SI+3],AL
6257 FEC3      813      INC BL
6259 8A07      814      MOV AL,[BX]
625B 884404    815      MOV [SI+4],AL
625E FEC3      816      INC BL
6260 8A07      817      MOV AL,[BX]
6262 884405    818      MOV [SI+5],AL
6265 8B16FC1F  819      MOV DX,[TIMER_COUNTER]
6269 893406    820      MOV [SI+6],DX
626C 83C608    821      ADD SI,8
626F 81FE0030  822      CMP SI,PAGE_MEM
6273 7203      823      JC IBF_MEMO
6275 BE0020    824      MOV SI,HISTORY_BUFFER
6278 8936FE1F  825 IBF_MEMO:  MOV [INDEX_HISTORY],SI
627C E91800    826      JMP IBF_RET
827 ;
627F 8A07      828 IBF_2ND:  MOV AL,[BX]
6281 E680      829      OUT DROP_DATA_PORT,AL
6283 FEC3      830 IBF_SET:  INC BL
6285 891E0407  831      MOV [INDEX_TX_1],BX
6289 FECC      832      DEC AH
628B 88260807  833      MOV [CTRL_1_COUNT],AH
628F 7506      834      JNZ IBF_RET
6291 FEC9      835      DEC CL
6293 880E0607  836      MOV [CTRL_1],CL
837 ;
838 ;
839 ;-----IN_SERVICE LATCH RESET
6297 B80D00    840 IBF_RET:  MOV      AX,13
629A BA22FF    841      MOV      DX,0FF22H
629D EF        842      OUT      DX,AX
629E 61        843      DB      61H
629F 9D        844      POPF
62A0 FB        845      STI
62A1 CF        846      IRET
847 ;
848 ;
849 ;-----INTR 0-----
850 ;-----External status Intr.-----
851      ORG      06400H
852 ;00000000  CLI
853      PUSHF
854      DB      60H
855      IN      AL,ACNC

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

856 ;-----NEW VERSION-----
6404 8AC8      857      MOV      CL,AL
6406 B010      858      MOV      AL,00010000B
6408 E604      859      OUT      ACHC,AL
640A E404      860      IN       AL,ACHC
640C 8AE8      861      MOV      CH,AL
640E A03C07    862      MOV      AL,BYTE PTR [EXTRN_STAT]
6411 BAD0      863      MOV      DL,AL
6413 8AC5      864      MOV      AL,CH
6415 D0C0      865      ROL      AL
6417 D0C0      866      ROL      AL
6419 D0C0      867      ROL      AL
641B 7207      868      JC       LOY
641D 8AC1      869      MOV      AL,CL
641F 24DF      870      AND      AL,11011111B
6421 E90700    871      JMP      LOZ
872 ;-----
6424 8AC1      873 LOY:      MOV      AL,CL
6426 0C20      874      OR       AL,00100000B
6428 E90000    875      JMP      LOZ
642B A23C07    876 LOZ:      MOV      BYTE PTR [EXTRN_STAT],AL
642E 8AC2      877      MOV      AL,DL
6430 2410      878      AND      AL,00010000B
6432 8AE0      879      MOV      AH,AL
6434 8AC1      880      MOV      AL,CL
6436 2410      881      AND      AL,00010000B
6438 3AE0      882      CMP      AH,AL
643A 753A      883      JNZ      EXIT
643C 8AC2      884      MOV      AL,DL
643E 2420      885      AND      AL,00100000B
6440 8AE0      886      MOV      AH,AL
6442 8AD5      887      MOV      AL,CH
6444 2420      888      AND      AL,00100000B
6446 3AE0      889      CMP      AH,AL
6448 8AC2      890      MOV      AL,DL
644A 2480      891      AND      AL,10000000B
644C 8AE1      892      MOV      AH,CL
644E 80E480    893      AND      AH,10000000B
6451 32E0      894      XOR      AH,AL
6453 7521      895      JNZ      EXIT
6455 8AC1      896 TX_UNDRN: MOV      AL,CL
6457 2444      897      AND      AL,01000100B
6459 3C40      898      CMP      AL,01000000B
645B 7519      899      JNE      EXIT
645D B028      900      MOV      AL,00101000B
645F E604      901      OUT      ACHC,AL
6461 B8100E    902      MOV      AX,3600
6464 BA5AFF    903      MOV      DX,0FF5AH
6467 EF        904      OUT      DX,AX
6468 B801E0    905      MOV      AX,1110000000000001B
646B BA5EFF    906      MOV      DX,0FF5EH
646E EF        907      OUT      DX,AX
646F B80300    908      MOV      AX,0011B
6472 BA32FF    909      MOV      DX,0FF32H
6475 EF        910      OUT      DX,AX
911 ;
912 ;EXIT:      912      MOV      AL,00010000B

```

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HEWLETT-PACKARD: 8086 Assembler

SOURCE LINE

```

6476 B038      913 ;      OUT      ACHC,AL
6478 E604      914 EXIT:  MOV      AL,00111000B
647A B80C00    915      OUT      ACHC,AL
647D BA22FF    916      MOV      AX,12
6480 EF        917      MOV      DX,0FF22H
6481 B80000    918      OUT      DX,AX
6484 A21807    919 ;
6487 A31407    920      MOV AX,0
648A 61        921      MOV [TX_BUSY_FLAG],AL
648B 9D        922      MOV [ECHO_BACK_FLAG],AX
648C FB        923      DB      61H
648D CF        924      POPF
648E          925      STI
648F          926      IRET
6490          927
6491          928
6492          929
6493          930
6494          931
6495          932
6496          933
6497          934
6498          935
6499          936
6500 9C        937
6501 60        938
6502 8B1E1207  939
6503          940
6504          941
6505          942
6506 E400      943 ;-----INTR 0-----
6508 8807      944      ORG      06500H
650A 43        945 ;00000000      CLI
650B 8BC3      946 ;-----FIRST RX. INT SHORT-----
650D BAC4FF    947 ;
6510 EF        948      PUSHF
6511 B002      949      DB      60H
6513 BAC6FF    950      MOV      BX,WORD PTP [PAGE_SW]
6516 EF        951 ;
6517 B8FF00    952 NON:   IN      AL,ACHD      ;1ST DATA INPUT
651A BAC8FF    953      MOV      [BX],AL
651D EF        954      INC      BX
651E B846A2    955      MOV      AX,BX
6521 BACAFF    956      MOV      DX,0FFC4H
6522 EF        957      OUT      DX,AX
6523 B002      958      MOV      AL,02H
6524 EF        959      MOV      DX,0FFC6H
6525 B038      960      OUT      DX,AX
6527 E604      961      MOV      AX,255
6528          962      MOV      DX,0FFC8H
6529          963      OUT      DX,AX
652A          964      MOV      AX,0A246H      ;DMA START
652B          965      MOV      DX,0FFCAH
652C          966      OUT      DX,AX
652D          967 ;-----IN SERV. LATCH RESET-----
652E          968      MOV      AL,00111000B
652F          969      OUT      ACHC,AL

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

6529 B80C00      970      MOV      AX,12
652C BA22FF      971      MOV      DX,0FF22H
652F EF          972      OUT      DX,AX
6530 61          973      DB      61H
6531 9D          974      POPF
6532 FB          975      STI
6533 CF          976      IRET
                977
                978
                979
                980
981 ;-----INTR 0-----
982 ;-----Special Rx. Intr.-----
983      ORG      06600H
984 099999      984      CLI
985 ;
986 ;
987 ; ***** HDLC Rx Interrupt Operation *****
988 ;-----
989 ;
990 RX_INTERRUPT: PUSHF
991                DB 60H
992 RX_RCV:      CALL RX_RECEIVE
993                JC RX_CRC_ERR      ; CRC Error
994      ADD WORD PTR [RX_CRC_OK_Y0+2],1
995      ADC WORD PTR [RX_CRC_OK_Y0],0
996      MOV SI,[PAGE_SW]
997 ;
998      MOV BX,[SI]      ; BX = Receive Address
999      CMP BX,[ECU_ADDRESS]
1000     JZ MY_ADRS
1001     CMP BX,0FFFFH
1002     JZ MY_ADRS      ; Global Address
1003     CMP BX,0
1004     JNZ RX_RET
1005                ; SI --- ECU H Address
1006     MOV AX,[ECU_ADDRESS]      ; +1 L
1007     AND AX,[SI+3]      ; +2 Tx Length
1008     CMP AX,[SI+5]      ; +3 MASK H Address
1009     JNZ RX_RET      ; +4 L
1010                ; +5 Ref. H address
1011                ; +6 L
1012                ; +7 Real Tx Length
1013
6633 83C605      1014 MY_ALOHA: ADD SI,5      ; Aloha Address
1015 ;
6636 89361407     1016 MY_ADRS: MOV [ECHO_BACK_FLAG],SI      ; ECHO Back Buffer Address
1017 ;
1018      ADD      SI,100H
1019      AND      SI,3300H
1020      MOV      WORD PTR [PAGE_SW],SI
1021 ;
6646 B038        1022 RX_RET: MOV      AL,00111000B
6648 E604        1023      OUT      ACNC,AL
1024 ;-----
664A B80C00      1025      MOV      AX,12
664D BA22FF      1026      MOV      DX,0FF22H

```

HEWLETT-PACKARD: 3086 Assembler

## SOURCE LINE

```

6650 EF      1027      OUT      DX,AX
6651 B001    1028      MOV      AL,00000001B
6653 E604    1029      OUT      ACNC,AL
6655 B00F    1030      MOV      AL,00001111B
6657 E604    1031      OUT      MCNC,AL
6659 61      1032      DB      51H
665A 9D      1033      POPF
1034 ;-----
665B FB      1035      STI
665C CF      1036      IPET
1037 ;
665D 8306060001 1038 RX_CPC_ERP:  ADD WORD PTP [RX_CPC_ERP+2],1
6662 8316040000 1039      ADC WORD PTP [RX_CPC_ERP],0
6667 EBDD    1040      JMP RX_RET
1041 ;
6669 90      1042 RX_RECEIVE: NOP
666A B944A0   1043      MOV      AX,0A04AH      :DMA STOP
666D BACAFF   1044      MOV      DI,OFFCAH
6670 EF      1045      OUT      DX,AX
6671 B001    1046      MOV      AL,00000001B
6673 E604    1047      OUT      MCNC,AL
6675 E404    1048      IN      AL,MCNC      :STATUS INPUT
6677 D0C0    1049      POL      AL
6679 D0C0    1050      POL      AL
667B B050    1051      MOV      AL,00110000B      :ERROR RESET COM
667D E604    1052      OUT      ACNC,AL
667F B040    1053      MOV      AL,01000000B      :RESET CPC CHECK
6681 E604    1054      OUT      MCNC,AL
6683 B020    1055      MOV      AL,00100000B
6685 E604    1056      OUT      ACNC,AL
6687 C3      1057      RET
1058 ;-----
1059 ;-----NON SPECIFIC EOI-----
668B B80080   1060 EOI:      MOV      AX,8000H
668B BAZ2FF   1061      MOV      DI,OFF22H
668E EF      1062      OUT      DX,AX
668F C3      1063      RET
1064 ;-----
1065 ;-----TX_DISABLE_ROUTINE-----
1066 ;-----TIMER_1 INTF-----
1067      1067      OPG      06700H
1068 ;9999    1068      CLI
1069      1069      PUSHF
1070      1070      DB      60H
1071      1071      MOV      AX,3600
1072      1072      MOV      DI,OFF5AH
1073      1073      OUT      DX,AX
1074      1074      MOV      AL,0110000000000001B
1075      1075      MOV      DI,OFF5EH
1076      1076      OUT      DX,AX
1077      1077      MOV      AX,1011B
1078      1078      MOV      DI,OFF32H
1079      1079      OUT      DX,AX
1080 ;-----PTR 0A-----
6717 B028    1081      MOV      AL,00101000B
6719 E604    1082      OUT      ACNC,AL
1083 ;-----PTR 05A-----

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

671B 8005      1084      MOV      AL,00000101B
671D E604      1085      OUT      ACHC,AL
671F A03E07    1086      MOV      AL,BYTE PTR [TEMP_R_CH]
6722 2401      1087      AND      AL,00000001B
6724 F8        1088      CLC
6725 D0C0      1089      ROL      AL
6727 0CE0      1090      OR       AL,11100000B
6729 E604      1091      OUT      ACHC,AL
1092 ;-----RTS OFF-----
1093 ;-----PTR 01A-----
672B 8001      1094      MOV      AL,00000001B
672D E604      1095      OUT      ACHC,AL
672F 802D      1096      MOV      AL,00101101B
6731 E604      1097      OUT      ACHC,AL
1098 ;-----PTR 0A-----
6733 8080      1099      MOV      AL,10000000B
6735 E604      1100      OUT      ACHC,AL
1101 ;-----PTR 0A-----
1102 ;      MOV      AL,00010000B      ????????
1103 ;      OUT      ACHC,AL
1104 ;-----
6737 BA22FF    1105      MOV      DX,0FF22H
673A B80800    1106      MOV      AX,08
673D EF        1107      OUT      DX,AX
673E B80000    1108      MOV      AX,0      ;Tx end flag
6741 A21807    1109      MOV [TX_BUSY_FLAG],AL
6744 A31407    1110      MOV [ECHO_BACK_FLAG],AX
6747 61        1111      DB      61H
6748 9D        1112      POPF
6749 FB        1113      STI
674A CF        1114      IRET
1115 ;-----
1116 ;-----SET UP UCS-----
1117      ORG      07C00H
7C00 883FF8    1118      MOV      AX,0F83FH
7C03 BAA0FF    1119      MOV      DX,0FFA0H
7C06 EF        1120      OUT      DX,AX
7C07 EA000000F8 1121      DB      0EAH,0,0,0,0F8H      ;JUMP TO 0F8000H
1122 ;-----
1123      ORG      07FF0H
7FF0 EA0000C0FF 1124      DB      0EAH,000H,00H,0C0H,0FFH      ;JUMP TO 0FFC00H
1125
1126
1127
1128
1129
1130 ;
1131 ;-----
1132 ;*****
1133 ;***** Hajime *****
1134 ;*****
1135 ;-----
1136 ;
1137      ORG      300H
1138 ;
1139 HAJIMERUYO: 1139      NOP
0300 9D        1140      CALL POWER_DET_CMD
0301 E80000

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

0304 BE2008      1141 HAJIME1:      MOV SI, FROM_OBF_BF
0307 E80000      1142      CALL LOAD_FROM_DROP
030A 72F8        1143      JC HAJIME1
030C BE2008      1144      MOV SI, FROM_OBF_BF
030F 8A4401      1145      MOV AL, [SI+1]
0312 3C01        1146      CMP AL, 1
0314 75EE        1147      JNZ HAJIME1      ; IF Response <> Power Det. Then Wait
                1148 ;
0316 E80000      1149      CALL POWER_DET_CMD
0319 BE2008      1150 HONBANI:      MOV SI, FROM_OBF_BF
031C E80000      1151      CALL LOAD_FROM_DROP
031F 72F8        1152      JC HONBANI
0321 BE2008      1153      MOV SI, FROM_OBF_BF
0324 8A4401      1154      MOV AL, [SI+1]
0327 3C01        1155      CMP AL, 1
0329 75EE        1156      JNZ HONBANI      ; IF Response <> Power Det. Then Wait
                1157 ;
032B 8A7402      1158      MOV DH, [SI+2]      ; DH = Power Detect Data
032E B210        1159      MOV DL, 10H      ; DL = 1st ID_BYTE --- 10H
0330 00CE        1160 DROP_INIT_LP: ROR DH
0332 7363        1161      JNC DRP_NEXT      ; IF CY=0 Then Power Down
                1162 ;
0334 52          1163 DEV_INIT_LP: PUSH DX
0335 8B162C07     1164      MOV [ID_BYTE], DL
0339 E80000      1165      CALL ID_DROP_DEVICE
033C E80000      1166      CALL SPU_STATUS_REQ
033F BE2008      1167 DEV_RESP_WT: MOV SI, FROM_OBF_BF
0342 E80000      1168      CALL LOAD_FROM_DROP
0345 72F8        1169      JC DEV_RESP_WT
0347 BE2008      1170      MOV SI, FROM_OBF_BF      ; SI --- Length
                1171      ; +1 Command
                1172      ; +2 ID_BYTE
                1173      ; +3 Byte Count
                1174      ; +4 Data
034A B004        1175      MOV AL, 4
034C 3A4401      1176      CMP AL, [SI+1]
034F 75EE        1177      JNZ DEV_RESP_WT      ; IF [SI+1]=4 Then 04 Command
                1178 ;
0351 8A4402      1179      MOV AL, [SI+2]
0354 3A062C07     1180      CMP AL, [ID_BYTE]
0358 75E5        1181      JNZ DEV_RESP_WT      ; IF CMD NEQ Status Then Wait Loop
                1182 ;
035A E000        1183      MOV AL, 0
035C 3A4403      1184      CMP AL, [SI+3]
035F 742D        1185      JZ DEV_NEXT      ; VLF Error (Device Off)
                1186 ;
0361 8A4404      1187      MOV AL, [SI+4]
0364 24F8        1188      AND AL, 0F8H
0366 75D7        1189      JNZ DEV_RESP_WT      ; Status Response deny
                1190 ;
0368 8A5405      1191      MOV DL, [SI+5]      ; <<< DL = Status >>>
036B E80000      1192      CALL CONV_SW_BIT_AL      ; SI --- CONVSEL ( Drop_NO. )
                1193      ; AL --- < Device >
036E 80E280      1194      AND DL, 80H      ;
0371 740E        1195      JZ DEV_SW_0      ; IF <7>=0 Then Converter SW=0
0373 8A262607     1196 DEV_SW_1: MOV AH, [DROP_NO]
0377 80E401      1197      AND AH, 1

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

037A 7509      1198      JNZ DEV_CLR      ; IF ODD Drop Then Converter SW=0 Else Abnorma
037C 0804      1199      OR [SI],AL
037E E90400    1200      JMP DEV_CLR
0381 343F      1201 DEV_SW_0: XOR AL,3FH
0383 2004      1202      AND [SI],AL
                1203 ;
* 0385 E80000    1204 DEV_CLR: CALL SPU_RELAY_OFF
0388 E80000    1205      CALL SPU_CLEAR_DISP
038B E80000    1206      CALL EVENT_LED_OFF
                1207 ;
* 038E 5A       1208 DEV_NEXT: POP DX
038F 80C208    1209      ADD DL,8      ; 00** *DDD
* 0392 80FA30   1210      CMP DL,30H    ; 0011 0DDD
0395 729D      1211      JC DEV_INIT_LP ; IF Device<6 Then Next Device
                1212 ;
0397 80E207    1213 DRP_NEXT: AND DL,7
039A FEC2      1214      INC DL      ; Next Drop
* 039C 80FA06   1215      CMP DL,6    ; IF Drop>5 Then Next Operation
039F 7305      1216      JNC POLLING_SEQ
03A1 80CA10    1217      OR DL,10H   ; Next Device Start from "2"
03A4 EB8A      1218      JMP DROP_INIT_LP
                1219
                1220
                1221
                1222
03A6 E80000    1223 POLLING_SEQ: CALL DROP_MAP_SET      ;=
                1224 ;=
03A9 E80000    1225      CALL DEVICE_MAP_SET ;= DROP 0
03AC FE062407  1226      INC BYTE PTR [CONV_NO] ;=
03B0 E80000    1227      CALL DEVICE_MAP_SET ;= DROP 1
03B3 FE062407  1228      INC BYTE PTR [CONV_NO] ;=
03B7 E80000    1229      CALL DEVICE_MAP_SET ;= DROP 2
03BA FE062407  1230      INC BYTE PTR [CONV_NO] ;=
03BE E80000    1231      CALL DEVICE_MAP_SET ;= DROP 3
03C1 FE062407  1232      INC BYTE PTR [CONV_NO] ;=
03C5 E80000    1233      CALL DEVICE_MAP_SET ;= DROP 4
03C8 FE062407  1234      INC BYTE PTR [CONV_NO] ;=
03CC E80000    1235      CALL DEVICE_MAP_SET ;= DROP 5
                1236
                1237
                1238
                1239
                1240
                1241
                1242
                1243
                1244
                1245
                1246
                1247 ;
                1248 ;
                1249 ;-----
                1250 ;*****
                1251 ;***** Main Routine *****
                1252 ;*****
                1253 ;-----
                1254 ;

```



HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1253 ;
03CF E82C01 1256 MAIN_LOOP: CALL FORWARD_CMD_CK ; Cy Flag = 1 Active
03D2 E81100 1257 CALL TIMER_OPERAT
03D5 7205 1258 JC KEY_APPLICAT
1259
1260
1261
1262
1263 ;
03D7 E8CD04 1264 DROP_ACCESS: CALL DROP_RESPONSE ; Response no kaishaku
03DA 7305 1265 JNC ECU_ADRS_NEW ; ----> Shori Nshi
1266
1267
1268
1269
1270 ;
03DC E80000 1271 KEY_APPLICAT: CALL KEY_OPERATION ; ----> Key shori
03DF EBEE 1272 JMP MAIN_LOOP
1273
1274
1275
1276
1277 ;
03E1 E82903 1278 ECU_ADRS_NEW: CALL ECU_ADRS_READ
03E4 EBEE 1279 JMP MAIN_LOOP
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289 ;
1290 ; ***** Subroutine *****
1291 ;
03E6 E8FB00 1292 TIMER_OPERAT: CALL TIMER_CHK
03F9 7202 1293 JC TIMER_Y0
03EB F8 1294 CLC
03EC C3 1295 RET
1296 ;
03ED FF06FC1F 1297 TIMER_Y0: INC WORD PTR [TIMER_COUNTER]
1298 ;
1299
1300
03F1 8B16FC1F 1301 TIMER_TOB2: MOV DX,[TIMER_COUNTER]
03F5 80FA00 1302 CMP DL,0
03F8 7568 1303 JNZ TIMER_TYPE_2
03FA 80E607 1304 AND DH,7
03FD 80FE06 1305 CMP DH,6
0400 7360 1306 JNC TIMER_TYPE_2
1307 ;
0402 B001 1308 MOV AL,1
0404 8ACE 1309 MOV CL,DH ; DH = CONV_NO
0406 D2C0 1310 ROL AL,CL ; AL = CONV_NO_BIT
0408 B4068007 1311 TEST AL,[NOW_EVENT]

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

040C 7454      1312      JZ TIMER_TYPE_2
040E 8700      1313      MOV BH,0
0410 8ADE      1314      MOV BL,DH
                   1315 ; ***** PAY Channel View *****
0412 BE3000    1316      MOV SI,EVENT_CHANNEL
0415 03F3      1317      ADD SI,BX
0417 8A1C      1318      MOV BL,[SI] ; BL = EVENT View Channel
0419 BE0006    1319      MOV SI,ES_EVENT_TIMER ; Counter Up & Pay ?
041C 8AE6      1320      MOV AH,DH
041E B000      1321      MOV AL,0
0420 D1C8      1322      ROR AX
0422 03F0      1323      ADD SI,AX
0424 268A20    1324      MOV AH,ES:[SI][BX]
0427 80FCF8    1325      CMP AH,0F8H
042A 7336      1326      JNC TIMER_TYPE_2
042C 26800008  1327      ADD BYTE PTR ES:[SI][BX],8
0430 268038F8  1328      CMP BYTE PTR ES:[SI][BX],0F8H
0434 722C      1329      JC TIMER_TYPE_2
                   1330 ;
0436 800E8007C0 1331      OR BYTE PTR [NOV_EVENT],0C0H
043B 80CE10    1332      OR DH,10H
043E 88362807  1333      MOV [IC_BYTE],DH
0442 E80000    1334      CALL CONV_TO_DROP
0445 E80000    1335      CALL ID_DROP_DEVICE
                   1336 ;
0448 A02E07    1337      MOV AL,[CONV_NO_BIT]
044B 343F      1338      XOR AL,3FH
044D 2068107   1339      AND BYTE PTR [BEFOR_EVENT],AL
                   1340 ;
0451 BE3000    1341      MOV SI,EVENT_CHANNEL
0454 03362407  1342      ADD SI,[CONV_NO]
0458 8A1C      1343      MOV BL,[SI]
045A 8700      1344      MOV BH,0
045C E80000    1345      CALL BINDEC_LED
045F E80000    1346      CALL RUN_CONVERTER
                   1347 ;
0462 8B1EFC1F  1348 TIMER_TYPE_2: MOV BX,[TIMER_COUNTER]
0466 81E3FF0F  1349      AND BX,0FFFH
                   1350 ;
046A 81FB0004  1351      CMP BX,ES_BACK_UP_2 ; 1024
046E 734C      1352      JNC TIMER_TOB
0470 81FB0002  1353      CMP BX,ES_BACK_UP_1 ; 512
0474 721B      1354      JC MOV_1_ST
                   1355 ;
0476 268A07    1356 MOV_2_ND: MOV AL,ES:[BX+ES_BACK_UP] ; BX = 512 - 1024
0479 2688870002 1357      MOV ES:[BX+ES_BACK_UP_1],AL
047E 753C      1358      JNZ TIMER_TOB
0480 26C7060002 1359      MOV WORD PTR ES:[ES_BACK_UP_1],0A5A5H
0487 26C7060004 1360      MOV WORD PTR ES:[ES_BACK_UP_2],0
048E E92B00    1361      JMP TIMER_TOB
                   1362 ;
0491 83FB04    1363 MOV_1_ST: CMP BX,4
0494 7214      1364      JC MOV_1_INIT
0496 8A07      1365      MOV AL,[BX]
0498 2688870002 1366      MOV ES:[BX+ES_BACK_UP_1],AL
049D 2630060202 1367      XOR ES:[ES_BACK_UP_1+2],AL
04A2 2600060302 1368      ADD ES:[ES_BACK_UP_1+3],AL

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

04A7 E91200      1369      JMP TIMER_TOB
                  1370 ;
04AA 26C6870002  1371 MOV_1_INIT:  MOV BYTE PTR ES:[BX+ES_BACK_UP_1],0
04B0 83FB00      1372      CMP BX,0
04B3 7507        1373      JNZ TIMER_TOB
04B5 26C7060004  1374      MOV WORD PTR ES:[ES_BACK_UP_2],0A5A5H
                  1375 ;
04BC 81E33F00    1376 TIMER_TOB:  AND BX,3FH                      ; 00** ****
04C0 8B1E2807    1377      MOV [IC_BYTE],BL
04C4 02DB        1378      ADD BL,BL
04C6 BE0003      1379      MOV SI,TIME_TABLE
04C9 8B00        1380      MOV AX,[SI][BX]
04CB 3DFFFF      1381      CMP AX,0FFFFH
04CE 7412        1382      JZ TIMER_SLEEP           ; Timer wa Tukawanai
04D0 FF08        1383      DEC WORD PTR [SI][BX]
04D2 750E        1384      JNZ TIMER_SLEEP           ; <--- Madada
                  1385 ;
04D4 8100        1386      MOV CL,TIMER_OUT_CODE
04D6 8B0E8907    1387      MOV [KEY_DATA],CL
04DA E80000      1388      CALL IC_DROP_DEVICE
04DD E80000      1389      CALL CONV_TO_DROP
                  1390 ;
04E0 F9          1391 TIMER_ACTIVE: STC
04E1 C3          1392      RET
                  1393 ;
                  1394
                  1395
04E2 F8          1396 TIMER_SLEEP: CLC
04E3 C3          1397      RET
                  1398
                  1399 ;
1400 ; ***** Timer Counter Check *****
1401 ;
1402 ; *****SUBROUTINE FOR COUNT SEC*****
04E4 BA66FF      1403 TIMER_CHK:  MOV     DX,0FF66H
04E7 ED          1404      IN      AX,DX
04E8 A92000      1405      TEST    AX,0020H
04EB F8          1406      CLC
04EC 740F        1407      JZ      RETTIM2
04EE B80008      1408      MOV     AX,0800H
04F1 BA62FF      1409      MOV     DX,0FF62H
04F4 EF          1410      OUT     DX,AX
04F5 B801C0      1411      MOV     AX,1100000000000001B
04F8 BA66FF      1412      MOV     DX,0FF66H
04FB EF          1413      OUT     DX,AX
04FC F9          1414      STC
04FD C3          1415 RETTIM2:  RET
                  1416
                  1417
                  1418
                  1419
                  1420
                  1421
                  1422
                  1423
                  1424
                  1425

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439 ;
1440 ;-----
1441 ;*****
1442 ;***** HDLC Forward Command *****
1443 ;*****
1444 ;-----
1445 ;
04FE 8B361407 1446 FORWARD_CMD_CHK: MOV SI,[ECHO_BACK_FLAG]
0502 83FE00 1447 CMP SI,0
0505 7503 1448 JNZ FORWARD_COME
0507 E90102 1449 JMP TX_CCC_N_RET
1450
050A C706140700 1451 FORWARD_COME: MOV WORD PTR [ECHO_BACK_FLAG],0 ; SI=Data Buffer Address
0510 8A4403 1452 MOV AL,[SI+3] ; +0 --- ECU H Address
0513 3C80 1453 CMP AL,80H ; +1 L
0515 7333 1454 JNC FORWARD_CMDTBL ; +2 Rx Data Length
0517 3C20 1455 CMP AL,20H ; +3 Command
0519 7303 1456 JNC CCC_CMD_20_7F
051B E98501 1457 JMP CCC_DROP_CMD ; 00 - 1F Command
1458 ;
051E 740A 1459 CCC_CMD_20_7F: JZ FORCED_KEY ; 20 - 7F Command
0520 3C30 1460 CMP AL,30H
0522 7403 1461 JZ COLD_START
0524 E9E401 1462 JMP TX_CCC_N_RET
1463 ;
0527 E9D6FA 1464 COLD_START: JMP RUN ; ***** Cold Start *****
1465 ;
052A 8A4404 1466 FORCED_KEY: MOV AL,[SI+4]
052D A22807 1467 MOV [IC_BYTE],AL
0530 8A6405 1468 MOV AH,[SI+5]
0533 8B268907 1469 MOV [KEY_DATA],AH
0537 E80000 1470 CALL IC_DROP_DEVICE
053A E80000 1471 CALL CONV_TO_DROP
053D E80000 1472 CALL KEY_OPERATION
0540 F9 1473 STC
0541 C3 1474 RET
1475 ;
0542 5B 1476 FORWARD_JUMP: POP BX
0543 0308 1477 ADD BX,AX
0545 8A4403 1478 MOV AL,[SI+3]
0548 53 1479 PUSH BX
0549 C3 1480 RET
1481 ;
054A 2C80 1482 FORWARD_CMDTBL: SUB AL,80H

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

054C 25FC00	1483	AND AX,0FCH	
054F E8F0FF	1484	CALL FORWARD_JUMP	
	1485 ;		
0552 E97C00	1486	CCC_CMD_JMPTBL: JMP SEND_FUNC_MOD	; 80H ---
0555 90	1487	NOP	
0556 E99600	1488	JMP SEND_RESPONSE	; 84H ---
0559 90	1489	NOP	
055A E90000	1490	JMP PAY_GROUP_1	; 88H ---
055D 90	1491	NOP	
055E E90000	1492	JMP PAY_GROUP_2	; 8CH ---
0561 90	1493	NOP	
0562 E9A601	1494	JMP TX_CCC_N_RET	; 90H ---
0565 90	1495	NOP	
0566 E9A201	1496	JMP TX_CCC_N_RET	; 94H ---
0569 90	1497	NOP	
056A E99E01	1498	JMP TX_CCC_N_RET	; 98H ---
056D 90	1499	NOP	
056E E99A01	1500	JMP TX_CCC_N_RET	; 9CH ---
0571 90	1501	NOP	
0572 E99601	1502	JMP TX_CCC_N_RET	; A0H --- [Ino]
0575 90	1503	NOP	
0576 E99201	1504	JMP TX_CCC_N_RET	; A4H --- [Ino]
0579 90	1505	NOP	
057A E98E01	1506	JMP TX_CCC_N_RET	; A8H --- [Ino]
057D 90	1507	NOP	
057E E98A01	1508	JMP TX_CCC_N_RET	; ACH --- [Ino]
0581 90	1509	NOP	
0582 E98601	1510	JMP TX_CCC_N_RET	; B0H --- [Ino]
0585 90	1511	NOP	
0586 E98201	1512	JMP TX_CCC_N_RET	; B4H --- [Ino]
0589 90	1513	NOP	
058A E97E01	1514	JMP TX_CCC_N_RET	; B8H --- [Ino]
058D 90	1515	NOP	
058E E97A01	1516	JMP TX_CCC_N_RET	; BCH --- [Ino]
0591 90	1517	NOP	
0592 E97601	1518	JMP TX_CCC_N_RET	; C0H --- [Ben]
0595 90	1519	NOP	
0596 E97201	1520	JMP TX_CCC_N_RET	; C4H --- [Ben]
0599 90	1521	NOP	
059A E96E01	1522	JMP TX_CCC_N_RET	; C8H --- [Ben]
059D 90	1523	NOP	
059E E96A01	1524	JMP TX_CCC_N_RET	; CCH --- [Ben]
05A1 90	1525	NOP	
05A2 E96601	1526	JMP TX_CCC_N_RET	; D0H ---
05A5 90	1527	NOP	
05A6 E96201	1528	JMP TX_CCC_N_RET	; D4H ---
05A9 90	1529	NOP	
05AA E95E01	1530	JMP TX_CCC_N_RET	; D8H ---
05AD 90	1531	NOP	
05AE E95A01	1532	JMP TX_CCC_N_RET	; DCH ---
05B1 90	1533	NOP	
05B2 E95601	1534	JMP TX_CCC_N_RET	; E0H ---
05B5 90	1535	NOP	
05B6 E95201	1536	JMP TX_CCC_N_RET	; E4H ---
05B9 90	1537	NOP	
05BA E94E01	1538	JMP TX_CCC_N_RET	; E8H ---
05BD 90	1539	NOP	

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

058E E94A01    1540      JMP TX_CCC_N_RET      ; ECH ---
05C1 90        1541      NOP
05C2 E95500    1542      JMP ECHO_BACK_CMD    ; F0H ---
05C3 90        1543      NOP
05C6 E9E300    1544      JMP FORCED_TUNE      ; F4H ---
05C9 90        1545      NOP
05CA E95A00    1546      JMP DISPLAY_MEMORY   ; F8H ---
05CD 90        1547      NOP
05CE E99300    1548      JMP STORE_MEMORY    ; FCH ---
               1549 ;
               1550 ; ***** Send Function Response *****
               1551 ;
05D1 2403      1552 SEND_FUNC_MOD: AND AL,3                ; 80 - 83 Command
05D3 7407      1553      JZ S_F_M_SET
05D5 3C01      1554      CMP AL,1
05D7 740D      1555      JZ S_F_M_CLR
05D9 E92F01    1556      JMP TX_CCC_N_RET      ; 82 - 83 Command
               1557 ;
05DC 8A6404    1558 S_F_M_SET:  MOV AH,[SI+4]                ; 80 Command
05DF 8B263008  1559      MOV [SEND_ENABLE],AH
05E3 E92501    1560      JMP TX_CCC_N_RET
               1561 ;
05E6 B400      1562 S_F_M_CLR:  MOV AH,0                ; 81 Command
05E8 8B263308  1563      MOV [SEND_INDEX],AH
05EC E91C01    1564      JMP TX_CCC_N_RET
               1565 ;
05EF 8A263308  1566 SEND_RESPONSE: MOV AH,[SEND_INDEX]          ; 84 - 87 Command
05F3 80FC00    1567      CMP AH,0
05F6 741F      1568      JZ NO_SEND
05F8 8A6403    1569 YES_SEND:  MOV AH,[SI+3]
05FB 8B263408  1570      MOV [SEND_CMD_RESP],AH
05FF 2403      1571      AND AL,3
0601 A21607    1572      MOV [REVERS_CHANEL],AL
0604 FE063308  1573      INC BYTE PTR [SEND_INDEX]
0608 FE063308  1574      INC BYTE PTR [SEND_INDEX]
060C BE3108    1575      MOV SI,SEND_ADDRESS
060F A10014    1576      MOV AX,[ECU_ADDRESS]
0612 8904      1577      MOV [SI],AX
0614 E9D600    1578      JMP TX_CCC_RUN
               1579 ;
0617 E9F100    1580 NO_SEND:  JMP TX_CCC_N_RET
               1581 ;
               1582 ; ***** Echo Back Command *****
               1583 ;
061A 2403      1584 ECHO_BACK_CMD: AND AL,3                ; Command != 0F0H
061C A21607    1585      MOV [REVERS_CHANEL],AL          ; Reverse Channel Command
061F A10014    1586 ECHO_BACK_SURU: MOV AX,[ECU_ADDRESS]
0622 8904      1587      MOV [SI],AX
0624 E9C600    1588      JMP TX_CCC_RUN
               1589 ;
               1590 ; ***** Display Memory *****
               1591 ;
0627 8B5C05    1592 DISPLAY_MEMORY: MOV BX,[SI+5]                ; <<< Display Memory >>>
062A 8A4403    1593      MOV AL,[SI+3]
062D A20314    1594      MOV [TX_COMMAND],AL
0630 8A4404    1595      MOV AL,[SI+4]                ; SI --- ECU Address H
0633 BE0414    1596      MOV SI,TX_BUFFER            ; +1 ECU Address L

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

0636 A20214      1597      MOV [TX_LENGTH],AL      ; +2      Rx Length
0639 81FB0080    1598      CMP BX,8000H      ; +3      Command
063D 7310        1599      JNC DISP_MEM_5517
063F 8A27        1600 TX_TRNS2:  MOV AH,[BX]      ; +4      Tx Length
0641 8824        1601      MOV [SI],AH      ; +5      Tx Address L
0643 46          1602      INC SI      ; +6      Tx Address H
0644 43          1603      INC BX
0645 FEC8        1604      DEC AL
0647 75F6        1605      JNZ TX_TRNS2
0649 BE0014      1606      MOV SI,ECU_ADDRESS
064C E99E00      1607      JMP TX_CCC_RUN
                   1608 ;
064F 81E3FF7F    1609 DISP_MEM_5517: AND BX,7FFFH      ; Back Up Memory Display
0653 268A27      1610 TX_TRNS3:  MOV AH,ES:[BX]
0656 8824        1611      MOV [SI],AH
0658 46          1612      INC SI
0659 43          1613      INC BX
065A FEC8        1614      DEC AL
065C 75F5        1615      JNZ TX_TRNS3
065E BE0014      1616      MOV SI,ECU_ADDRESS
0661 E98900      1617      JMP TX_CCC_RUN
                   1618 ;
0664 8B5C05      1619 STORE_MEMORY: MOV BX,[SI+5]      ; <<< Store Memory >>>
0667 8A4403      1620      MOV AL,[SI+3]
066A A20314      1621      MOV [TX_COMMAND],AL
066D 8A4404      1622      MOV AL,[SI+4]      ; SI --- ECU Address H
                   1623      ; +1      ECU Address L
0670 A20214      1624      MOV [TX_LENGTH],AL      ; +2      Rx Length
0673 81FB0080    1625      CMP BX,8000H      ; +3      Command
0677 730E        1626      JNC STOR_MEM_5517
0679 8A6407      1627 ST_TRNS2:  MOV AH,[SI+7]      ; +4      St Length
067C 8827        1628      MOV [BX],AH      ; +5      St Address L
067E 46          1629      INC SI      ; +6      St Address H
067F 43          1630      INC BX
0680 FEC8        1631      DEC AL
0682 75F5        1632      JNZ ST_TRNS2
0684 E98400      1633      JMP TX_CCC_N_RET
                   1634 ;
0687 81E3FF7F    1635 STOR_MEM_5517: AND BX,7FFFH      ; Back Up Memory Display
068B 81FB0001    1636      CMP BX,100H
068F 7303        1637      JNC ST_TRNS3
0691 E97700      1638      JMP TX_CCC_N_RET      ; Sokowa Interrupt Table
0694 8A6407      1639 ST_TRNS3:  MOV AH,[SI+7]
0697 268827      1640      MOV ES:[BX],AH
069A 46          1641      INC SI
069B 43          1642      INC BX
069C FEC8        1643      DEC AL
069E 75F4        1644      JNZ ST_TRNS3
06A0 E96800      1645      JMP TX_CCC_N_RET
                   1646 ;
                   1647 ; ***** CCC ---> Data Processor ---> Drop Processor *****
                   1648 ;
06A3 83C602      1649 CCC_DROP_CMD: ADD SI,2
06A6 E80000      1650      CALL LOAD_TO_DROP
06A9 E95F00      1651      JMP TX_CCC_N_RET
                   1652 ;
0653 ; ***** Forced Tuning --- Nth Converter *****

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1654 ;
06AC 8A4404 1655 FORCED_TUNE: MOV AL,[SI+4] ; SI --- ECU H Address
06AF A22807 1656 MOV [IC_BYTE],AL ; +1 L Address
06B2 E80000 1657 CALL IC_DROP_DEVICE ; +2 Tx Data Length
06B5 E80000 1658 CALL CONV_TO_DROP ; +3 Command EOH
06B8 8A3C05 1659 MOV BL,[SI+5] ; +4 Converter NO.
06BB 80FB64 1660 CMP BL,100 ; +5 Tuning Channel
06BE 7312 1661 JNC FORCED_OFF
1662 ;
06C0 E80000 1663 FORCED_ON: CALL BINDEC_LED
06C3 E80000 1664 CALL LED_VIEW_TBL
06C6 E80000 1665 CALL SPU_LED_DISP
06C9 E80000 1666 CALL RUN_CONVERTER
06CC E80000 1667 CALL WAKEARI_DE_ON
06CF E93900 1668 JMP TX_CCC_N_RET
1669 ;
06D2 E80000 1670 FORCED_OFF: CALL OP_SPU_OFF
06D5 E93300 1671 JMP TX_CCC_N_RET
1672 ;
1673 ; ***** SPU to CCC Send *****
1674 ;
06D8 BE0214 1675 SPECIAL_SPU_1: MOV SI, TX_LENGTH
06DB B80207 1676 MOV BX, INDEX_RX_1
06DE C60441 1677 MOV BYTE PTR [SI], 65
06E1 C6440100 1678 MOV BYTE PTR [SI+1], 0
06E5 83C602 1679 ADD SI, 2
06E8 B040 1680 MOV AL, 64
06EA E952FF 1681 JMP TX_TRNS2
1682 ;
1683 ; ***** Send to CCC *****
1684 ;
06ED A01807 1685 TX_CCC_RUN: MOV AL, [TX_BUSY_FLAG]
06F0 3C00 1686 CMP AL, 0
06F2 7517 1687 JNZ TX_CCC_N_RET
1688 ;
06F4 8A4C02 1689 TX_RUN_SUB: MOV CL, [SI+2]
06F7 FEC1 1690 INC CL
06F9 FEC1 1691 INC CL
06FB 80F903 1692 CMP CL, 3
06FE 7302 1693 JNC TX_YOSHI
0700 B103 1694 MOV CL, 3
0702 880E1807 1695 TX_YOSHI: MOV [TX_BUSY_FLAG], CL ; [[[ SI --- Start Address ]]]
0706 E841FB 1696 CALL HDLC_TX_START ; [[[ CL --- Data Length ]]]
0709 F9 1697 STC
070A C3 1698 RET
1699 ;
1700 ;
1701 ;
070B F8 1702 TX_CCC_N_RET: CLC
070C C3 1703 RET
1704 ;
1705 ;
1706 ;
1707 ;
1708 ;
1709 ;
1710 ;

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HEWLETT-PACKARD: 8086 Assembler

SOURCE LINE

```

1711
1712
1713
1714
1715
1716 ;
1717 ;-----
1718 ;***** Subroutine *****
1719 ;*****
1720 ;*****
1721 ;-----
1722 ;
1723 ; ***** ECU Address Read Routine *****
1724 ;
070D BA0001 1725 ECU_ADRS_READ: MOV DX,ECU_L_ADDRESS
0710 EC 1726 IN AL,DX
0711 8AE0 1727 MOV AH,AL
0713 BA0201 1728 MOV DX,ECU_H_ADDRESS ; AH = L , AL = H Address.
0716 EC 1729 IN AL,DX
0717 A30014 1730 MOV [ECU_ADDRESS],AX
071A C3 1731 RET
1732 ;
1733 ; ***** Timer Table Initialize *****
1734 ;
071B BE0003 1735 INIT_TIM_TBL: MOV SI,TIME_TABLE
071E BB0000 1736 MOV BX,0
0721 C600FF 1737 INIT_TIM_LP: MOV BYTE PTR [SI][BX],0FFH
0724 43 1738 INC BX
0725 81FB0000 1739 CMP BX,128
0729 75F6 1740 JNZ INIT_TIM_LP
072B C3 1741 RET
1742 ;
1743 ; ***** Event Timer Table Initialize *****
1744 ;
072C BE0006 1745 INIT_EV_TIMER: MOV SI,ES_EVENT_TIMER
072F BB0000 1746 MOV BX,0
0732 26C60000 1747 INIT_EV_1: MOV BYTE PTR ES:[SI][BX],0
0736 43 1748 INC BX
0737 81FB0003 1749 CMP BX,128*6
073B 75F5 1750 JNZ INIT_EV_1
073D C3 1751 RET
1752 ;
1753 ; ***** JUMP_ADDRESS Table Initialize *****
1754 ;
073E E80300 1755 INIT_JUMP_TBL: CALL INIT_WA_DOKO
0741 E90000 1756 JMP OP_INITIAL
0744 5B 1757 INIT_WA_DOKO: POP AX
0745 A31C07 1758 MOV [INIT_POINT],AX
074B BE0003 1759 MOV SI,JUMP_ADDRESS
074B BB0000 1760 MOV BX,0
074E B900 1761 INIT_JUMP_LP: MOV [SI][BX],AX
0750 83C302 1762 ADD BX,2
0753 81FB0000 1763 CMP BX,128
0757 75F5 1764 JNZ INIT_JUMP_LP
0759 E80300 1765 CALL BASE_WA_DOKO
075C E90000 1766 JMP BASE_ROUTINE
075F 5B 1767 BASE_WA_DOKO: POP AX

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

0760 A31A07      1768      MOV [BASE_POINT],AX
0763 C3          1769      RET
                  1770 ;
                  1771 ; ***** BASIC_AUTHO Table Initialize *****
                  1772 ;
0764 BE0001      1773 INIT_AUTHO_TBL: MOV SI,PC_FC_LIST
0767 BB0000      1774      MOV BX,0
076A C60000      1775 JUNK0:  MOV BYTE PTR [SI][BX],0
076D 43          1776      INC BX
076E 81FB0001    1777      CMP BX,256
0772 73F6        1778      JNZ JUNK0
                  1779 ;
0774 BE8001      1780      MOV SI,BASIC_AUTHO
0777 BB0100      1781      MOV BX,1
077A C6003F      1782 JUN:   MOV BYTE PTR [SI][BX],3FH
077D 43          1783      INC BX
077E 83FB5A      1784      CMP BX,90
0781 73F7        1785      JNZ JUN
0783 C3          1786      RET
                  1787 ;
                  1788 ; ***** View Channel Table Initialize *****
                  1789 ;
0784 BE1000      1790 INIT_VIEW_TBL: MOV SI,VIEW_CHANNEL
0787 BB0000      1791      MOV BX,0
078A 8AE3        1792 INIT_VIEW_LP: MOV AH,BL
078C FEC4        1793      INC AH
078E 80CC30      1794      OR AH,30H
0791 C60030      1795      MOV BYTE PTR [SI][BX],30H
0794 8B6D08      1796      MOV BYTE PTR [SI][BX+8],AH
0797 43          1797      INC BX
0798 83FB08      1798      CMP BX,8
079B 73ED        1799      JNZ INIT_VIEW_LP
079D C3          1800      RET
                  1801 ;
                  1802 ; ***** EVENT Table MODE Initialize *****
                  1803 ;
079E BB0006      1804 EVENT_DATA_CL: MOV BX,ES_EVENT_TIMER
07A1 26C707FF0F  1805 CHI HARU: MOV WORD PTR ES:[BX],0FFFFH
07A6 83C302      1806      ADD BX,2
07A9 81FB0009    1807      CMP BX,ES_EVENT_TIMER+128*6
07AD 72F2        1808      JC CHI HARU
                  1809 ;
07AF BE0009      1810      MOV SI,EVENT_NO_FREQ
07B2 B120        1811      MOV CL,32
07B4 C744400100  1812 LP1:  MOV WORD PTR [SI+32*2],1
07B9 83C602      1813      ADD SI,2
07BC FEC1        1814      INC CL
07BE 80F93F      1815      CMP CL,63
07C1 73F1        1816      JNZ LP1
                  1817 ;
07C3 BE0009      1818      MOV SI,EVENT_NO_FREQ
07C6 BB0002      1819      MOV BX,CH_NO_FREQ
07C9 B140        1820      MOV CL,64
07CB 8B07        1821 LP2:  MOV AX,[BX]
07CD 89848000    1822      MOV [SI+64*2],AX
07D1 83C602      1823      ADD SI,2
07D4 83C302      1824      ADD BX,2

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

07D7 FEC1      1825      INC CL
07D9 80F980    1826      CMP CL,128
07DC 75ED      1827      JNZ LP2

1828 ;
1829      RET
07DE C3        1830 ;
1831 ; ***** PC_CODE & PR_CODE Initialize *****
1832 ;
07DF BE2000    1833 INIT_CODE:  MOV SI,PC_CODE
07E2 8B0000    1834      MOV BX,0
07E5 C7000000  1835 INIT_CODE_LP:  MOV WORD PTR [SI][BX],0
07E9 83C302    1836      ADD BX,2
07EC 83FB10    1837      CMP BX,16
07EF 75F4      1838      JNZ INIT_CODE_LP
07F1 C3        1839      RET
1840 ;
1841 ; ***** Converter Frequency Calculation *****
1842 ;
07F2 C7063A0703 1843 FREQ_CALC:  MOV      WORD PTR DS:[MUL_ADR],MUL_NO
07F8 B90000    1844      MOV      CX,0      ;A-CABLE
07FB B84000    1845      MOV      AX,64
07FE 48        1846 CAL_STDA:  DEC      AX
07FF E81500    1847      CALL     FREQ_CAL
0802 3D0000    1848      CMP      AX,0
0805 75F7      1849      JNZ      CAL_STDA
0807 B9FF00    1850      MOV      CX,0FFH  ;B-CABLE
080A B84000    1851      MOV      AX,64
080D 48        1852 CAL_STDB:  DEC      AX
080E E80600    1853      CALL     FREQ_CAL
0811 3D0000    1854      CMP      AX,0
0814 75F7      1855      JNZ      CAL_STDB
0816 C3        1856      RET
1857 ; ***** STD FREQ. CALCULATION SUBROUTINE*****
0817 80E120    1858 FREQ_CAL:  AND      CL,00100000B
081A 50        1859      PUSH     AX
081B 8BD0      1860      MOV      DX,AX
081D 754E      1861      JNZ      UP64      ;B-CABLE ==>UP64
081F 3D0000    1862 UP64_D:  CMP      AX,0
0822 743A      1863      JE       ZERO
0824 3D3F00    1864      CMP      AX,63
0827 7435      1865      JE       ZERO
0829 3D0600    1866      CMP      AX,6
082C 7335      1867      JNC      CH6_62    ;CHANNELL ARE FROM 6 TO 62
082E 3D0400    1868      CMP      AX,4
0831 7335      1869      JNC      CH4_5     ;CHANNELL ARE FROM 4 TO 5
0833 B84B01    1870      MOV      BX,331
0836 F6263A07  1871 MULTI:  MUL      BYTE PTR DS:[MUL_ADR]      ;CH_NO*3
083A 03C3      1872      ADD      AX,BX      ;CH_NO*3+OFFSE
083C 80F900    1873 ADDER:  CMP      CL,0
083F 7400      1874      JZ       ADDER_1
1875 ;;;
0841 80E403    1876 ADDER_1:  AND      AH,00000011B
0844 FB        1877      CLC
0845 D0C4      1878      ROL      AH
0847 D0C4      1879      ROL      AH
0849 D0C4      1880      ROL      AH
084B D0C4      1881      ROL      AH

```

FILE: DST\_MAIN.DST

HEWLETT-PACKARD: 8086 Assembler

LOCATION	OBJECT	CODE	LINE	SOURCE	LINE
084D	D0C4		1882	ROL	AX
084F	D0C4		1883	ROL	AX
0851	0AE1		1884	OR	AX,CL
0853	BB0002		1885	MOV	BX,CH_NO_FREQ
0855	08F2		1886	MOV	SI,DX
0858	03F2		1887	ADD	SI,DX
085A	0700		1888	MOV	[BX][SI],AX
085C	58		1889	POP	AX
085D	C3		1890	RET	
085E	080000		1891		
0861	EBD9		1892	ZERO:	MOV
			1893	JMP	AX,0
			1894		ADDER
0883	083701		1895	CM5_62:	MOV
0866	EBCE		1896	JMP	BX,343
			1897		MULTI
0868	0B4D01		1898	CM4_3:	MOV
0860	EBCE		1899	JMP	BX,333
			1900		MULTI
086D	03C240		1901	UP64:	ADD
0870	EBAD		1902	JMP	DX,64
			1903		UP64_D
			1904		
			1905		
0872	BE0002		1906	CHANNEL_HOSE1:	MOV
0873	093140		1907		SI,CH_NO_FREQ
0876	098C8E00		1908		MOV
			1909		CX,4031H
			1910		MOV
			1911		[SI+71*2],CX
087C	096440		1912		
087F	098C9200		1913		MOV
			1914		CX,4066H
			1915		MOV
			1916		[SI+74*2],CX
0883	098040		1917		
0886	098C9400		1918		MOV
			1919		CX,408EH
088A	098E40		1920		MOV
088D	098C9800		1921		[SI+76*2],CX
			1922		
0891	099340		1923		MOV
0894	098C9C00		1924		CX,4093H
			1925		MOV
			1926		[SI+78*2],CX
0898	099940		1927		
089B	098CA000		1928		MOV
			1929		CX,409FH
089F	099F40		1930		MOV
08A2	098CA400		1931		[SI+80*2],CX
08A6	C3		1932		
			1933		RET
			1934		
			1935		
			1936		
			1937		
			1938		
08A7	BE2000		1939		
08AA	EB0000		1940		
08AD	7215		1941		
08AF	BE2000		1942		
08B2	0A4401		1943		
08B5	3C01		1944		
08B7	7400		1945		
08B9	3C04		1946		

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

08BB 740B      1939      JZ DROP_RESP_04
08BD 3C84      1940      CMP AL,84H
08BF 7503      1941      JNZ DROP_RESP_NOP
08C1 E99F00    1942      JMP DROP_RESP_84
08C4 F8        1943 ;
08C5 C3        1944 DROP_RESP_NOP: CLC          ; Key Data None ---> CY=0
08C6 EBFC      1945      RET
08C7          1946 ;
08C8 8A4402    1947 ; -----[SI]--[+1]---[+2]-----
08CB A22C07    1948 DROP_RESP_01: JMP DROP_RESP_NOP ; [01][POW.DETECT]
08CE E80000    1949 ; -----[SI]--[+1]---[+2]---[+3][+4]---[+5]---
08D1 BE2008    1950 DROP_RESP_04: MOV AL,[SI+2]
08D4 8A4C03    1951      MOV [ID_BYTE],AL
08D7 80F900    1952      CALL ID_DROP_DEVICE
08DA 7466      1953 ;
08DC BF8000    1954      MOV SI,FROM_0BF_BF
08DF B700      1955      MOV CL,[SI+3] ; [04][ID_BYTE][02][00][STATUS]
08E1 8A1E2C07 1956      CMP CL,0 ; 00 **
08E3 03DB      1957      JZ RESP_VLF_ERR
08E7 8121FEFF 1958      MOV DI,VLF_ERROR_MAP
08EB 8A6C04    1959      MOV BH,0
08EE 80FD00    1960      MOV BL,[ID_BYTE]
08F1 7402      1961      ADD BX,BX
08F3 EBCF      1962      AND WORD PTR [DI][BX],OFFFH
08F4          1963 ;
08F5 8A5405    1964      MOV CH,[SI+4] ; 02 00 **
08F8 80E204    1965      CMP CH,0
08FB 7431      1966      JZ RESP_STATUS
08FD 8A5405    1967      JMP DROP_RESP_NOP
0900 E80000    1968 ;
0903 80E280    1969 RESP_STATUS: MOV DL,[SI+5] ; [ Status ]
0906 7411      1970      AND DL,4 ; S * * * * P * *
0908 8A262607 1971      JZ KEY_DEPRESS ; - - - - - I
090B 7518      1972 RECENT_ON: MOV DL,[SI+5] ; - - - - - I
090D 80E000    1973      CALL CONV_SW_BIT_AL ; - SPU Recent Power ON
0910 80E000    1974      AND DL,80H ; - I
0913 E80000    1975      JZ CONV_SW_0 ; Converter Select SW
0916 E91000    1976 CONV_SW_1: MOV AH,[DROP_NO]
0919 8A24      1977      AND AH,1
091B 343F      1978      JNZ CONV_SW_SET
091D 2004      1979      OR [SI],AL
091F E80000    1980      CALL JUMP_ADRS_INIT
0922 22C4      1981      JMP CONV_SW_SET
0924 7403      1982 CONV_SW_0: MOV AH,[SI]
0926 E80000    1983      XOR AL,3FH
0929 E80000    1984      AND [SI],AL
092C F8        1985      CALL DROP_BIT_AL ; 10/19 Henkou !!!
092D C3        1986      AND AL,AH
092E 8A5405    1987      JZ CONV_SW_SET
0931 80E202    1988      CALL JUMP_ADRS_INIT
0934 740A      1989 CONV_SW_SET: CALL JUMP_ADRS_INIT
0935          1990      CLC
0936          1991      RET
0937          1992 ;
0938 8A5405    1993 KEY_DEPRESS: MOV DL,[SI+5] ; I
0939 80E202    1994      AND DL,2 ; Key Currently Depressed
093A 740A      1995      JZ ELSE_STATUS

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

0936 B01C      1996      MOV AL,KEY_PUSH_CODE
0938 A28907    1997      MOV [KEY_DATA],AL
0938 E80000    1998      CALL DROP_TO_CONV
093E F9        1999      STC
093F C3        2000      RET
0940 FB        2001 ELSE_STATUS: CLC
0941 C3        2002      RET
                2003 ;
0942 E80000    2004 RESP_VLF_ERR: CALL DROP_TO_CONV
0945 8E8000    2005      MOV SI,VLF_ERROR_MAP
0948 B700      2006      MOV BH,0
094A 8A1E2C07  2007      MOV BL,[ID_BYTE]
094E 03DB      2008      ADD BX,BX
0950 8B00      2009      MOV AX,[SI][BX]
0952 050200    2010      ADD AX,2
0953 350100    2011      XOR AX,1
0958 8900      2012      MOV [SI][BX],AX
095A D0C8      2013      ROR AL
095C 7303      2014      JNC VLF_ERR_RET
095E E80000    2015      CALL JUMP_ADRS_INIT
0961 F8        2016 VLF_ERR_RET: CLC
0962 C3        2017      RET
                2018 ; =====
0963 8A4C03    2019 DROP_RESP_84: MOV CL,[SI+3] ; [84][ID/DROP] [01][KEY]
0966 80F900    2020      CMP CL,0
0969 742D      2021      JZ RESP_84_NRET
                2022 ;
096B 8A6402    2023      MOV AH,[SI+2] ; ( AH ) = ID_BYTE
096E 8B262C07  2024      MOV [ID_BYTE],AH
                2025 ;
0972 E80000    2026      CALL ID_DROP_DEVICE ; ---> CONV_NO , DROP_NO , DEVICE_NO
0975 E80000    2027      CALL DROP_TO_CONV
                2028 ;
0978 8A6C04    2029      MOV CH,[SI+4]
097B 8B2E8907  2030      MOV [KEY_DATA].CH
                2031 ;
097F BE8000    2032      MOV SI,VLF_ERROR_MAP
0982 B700      2033      MOV BH,0
0984 8A1E2C07  2034      MOV BL,[ID_BYTE]
0988 03DB      2035      ADD BX,BX
098A 8120FEFF  2036      AND WORD PTR [SI][BX],0FFFEH
                2037 ;
098E 80FDFD    2038      CMP CH,0FFH
0991 7402      2039      JZ SENS_STATUS
0993 F9        2040      STC
0994 C3        2041      RET ; Push Key Board ---> CY=1
                2042 ;
0995 E80000    2043 SENS_STATUS: CALL SPU_STATUS_REQ ; 0FFH ---> No Key Stroke
0998 F8        2044 RESP_84_NRET: CLC
0999 C3        2045      RET
                2046 ;
                2047 ;
                2048 ;
0999          2049      GLOBAL SPECIAL_SPU_I
                2050 ;
                2051 ;
                2052 ;

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

2053	EXTRN	POWER_DET_CHD
2054	EXTRN	LOAD_FROM_DROP
2055	EXTRN	LOAD_TO_DROP
2056	EXTRN	SPU_STATUS_REQ
2057	EXTRN	ID_DROP_DEVICE
2058	EXTRN	IC_DPOP_DEVICE
2059	EXTRN	CONV_SW_BIT_AL
2060	EXTRN	DROP_BIT_AL
2061	EXTRN	SPU_RELAY_OFF
2062	EXTRN	SPU_CLEAR_DISP
2063	EXTRN	EVENT_LED_OFF
2064	EXTRN	DROP_MAP_SET
2065	EXTRN	KEY_OPERATION
2066	EXTRN	CONV_TO_DROP
2067	EXTRN	DROP_TO_CONV
2068	EXTRN	BINDEC_LED
2069	EXTRN	LED_VIEW_TBL
2070	EXTRN	SPU_LED_DISP
2071	EXTRN	RUN_CONVERTER
2072	EXTRN	WAKEARI_DE_ON
2073	EXTRN	OP_SPU_OFF
2074	EXTRN	OP_INITIAL
2075	EXTRN	BASE_ROUTINE
2076	EXTRN	JUMP_ADRS_INIT
2077	EXTRN	JUMP_ADRS_INIZ
2078	EXTRN	DEVICE_MAP_SET
2079		
2080	EXTRN	PAY_GROUP_1
2081	EXTRN	PAY_GROUP_2

Errors 0

## CROSS REFERENCE TABLE

SYMBOL	TYPE	REFERENCES
04 CTRL_1	A	443, 777, 801, 836
05 CTRL_1_COUNT	A	444, 778, 799, 833
08 CTRL_2	A	445, 779, 792
09 CTRL_2_COUNT	A	454, 603, 606, 757
DEVICE_MAP_SET	E	1225, 1227, 1229, 1231, 1233, 1235, 2070
102 DEVICE_MD	A	
106 DEVICE_MD_BIT	A	
1204 DEV_CLR	A	1190, 1200
1163 DEV_INIT_LP	A	1211
1208 DEV_NEXT	A	1195
1167 DEV_RESP_WT	A	1149, 1177, 1181, 1189
1201 DEV_SW_0	A	1175
1196 DEV_SW_1	A	
1592 DISPLAY_MEMORY	A	1546
1609 DISP_MEM_5517	A	1599
126 DOWN_FLAG	A	
1264 DROP_ACCESS	A	
DROP_BIT_WL	E	1995, 2060
143 DROP_CMD_BF	A	
230 DROP_CMD_POPT	A	793
231 DROP_DATA_POPT	A	681, 829
1160 DROP_INIT_LP	A	1218
DROP_MAP_SET	E	1223, 2064
100 DROP_MD	A	1196, 1976
105 DROP_MD_BIT	A	
1931 DROP_RESPONSE	A	1264
1948 DROP_PESP_01	A	1937
1950 DROP_PESP_04	A	1939
2019 DROP_PESP_04	A	1942
1944 DROP_RESP_HOP	A	1933, 1941, 1948, 1967
DROP_TO_CONV	E	1990, 2004, 2027, 2067
1212 DPP_NEXT	A	1161
128 DS1	A	121, 122, 123, 125, 126, 127, 128, 130, 131, 132, 133, 134, 135, 136, 137, 138
142 DS16	A	143, 144, 145, 147
81 DS2	A	92, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 99, 100, 101, 102, 103, 104, 105, 106, 108, 109, 110, 113
97 ECHO_BACK_ADDRS	A	
1584 ECHO_BACK_CMD	A	1542
91 ECHO_BACK_FLAG	A	447, 922, 1016, 1110, 1446, 1451
1586 ECHO_BACK_SUPU	A	
161 ECU_ADDRESSES	A	162, 163, 164, 909, 1006, 1576, 1586, 1606, 1616, 1730
1270 ECU_ADDRS_MEM	A	1265
1725 ECU_ADDRS_READ	A	461, 1270
232 ECU_H_ADDRESS	A	1718
233 ECU_L_ADDRESS	A	1725
2001 ELSE_STATUS	A	1995
1068 EOI	A	
182 ES_BACK_UP	A	1354
183 ES_BACK_UP_1	A	400, 409, 1337, 1357, 1359, 1766, 1767, 1769, 1371
184 ES_BACK_UP_2	A	477, 499, 1331, 1360, 1374
186 ES_EVENT_TIMEP	A	1310, 1745, 1804, 1807
62 EVENT_CHANNEL	A	1316, 1341
1804 EVENT_DATA_CL	A	472
123 EVENT_ENABLE	A	
194 EVENT_KEY_CODE	A	
EVENT_LED_OFF	E	1206, 2063
153 EVENT_MD_FREQ	A	1810, 1818
914 EXIT	A	683, 895, 899



## CP057 REFERENCE TABLE

SYMBOL	TYPE	REFERENCES
72 A200H	A	73,74,75,76
239 ACNC	A	143,346,354,362,370,373,377,381,339,369,371,374,392,404,610,614,642,955,959,960,901,915,969,1027,1029
		1031,1047,1048,1052,1054,1056,1062,1085,1091,1095,1097,1100
238 ACND	A	325,333,639,952
1073 ADDEP	A	1493
1076 ADDEP_1	A	1274
1006 ALDMD_CHECK	A	
214 ASCII_AD	A	
200 ASCII_AU	A	
212 ASCII_CL	A	
210 ASCII_CO	A	
215 ASCII_DE	A	
207 ASCII_ER	A	
210 ASCII_FC	A	
217 ASCII_MO	A	
216 ASCII_MU	A	
211 ASCII_PC	A	
219 ASCII_PP	A	
209 ASCII_SC	A	
213 ASCII_SE	A	
195 AUTHO_KEY_CODE	A	
486 BACK_UP_CP1	A	490
504 BACK_UP_CP2	A	509
514 BACK_UP_EXIT	A	462,493,510
483 BACK_UP_A=1	A	473
512 BACK_UP_NONE	A	195
497 BACK_UP_YES	A	
94 BASE_POINT	A	1769
		BASE_ROUTINE
1767 BASE_WA_DONE	A	1765
66 BASIC_AUTHO	A	1790
241 BCNC	A	350,358,366,384,388
240 BCND	A	
122 BEFOR_EVENT	A	1379
52 BIAS	N	55,56,57,58,59,60,61,62,64,65,66,276
96 BINARY_LET	A	
		BINDEC_LET
1046 CAL_STDA	A	1849
1052 CAL_STDB	A	1855
1459 CCC_CMD_20_7F	A	1454
1486 CCC_CMD_JMP10L	A	
1649 CCC_DROP_CMD	A	1457
1090 CM4_5	A	1049
1095 CM4_62	A	1067
1906 CHANNEL_MWSET	A	471
1805 CHIMARU	A	1800
73 CH_NO_FREQ	A	1019,1085,1906
199 CLEAR_KEY_CODE	A	
1464 COLD_START	A	1461
99 CONV_NO	A	431,1226,1229,1230,1232,1234,1344
104 CONV_NO_BIT	A	1337
117 CONV_SELECT	A	434,439,436,437
1982 CONV_SW_0	A	1975
1976 CONV_SW_1	A	
		CONV_SW_BIT_2L
1989 CONV_SW_SET	E	1192,1973,2059
		CONV_SW_SET
		CONV_TO_DROP
		1374,1389,1471,1658,2064

## CROSS REFERENCE TABLE

SYMBOL	TYPE	REFERENCES
109 EXTRN_STAT	A	530,862,876
1466 FORCED_KEY	A	1459
1670 FORCED_OFF	A	1661
1663 FORCED_ON	A	
1655 FORCED_TUNE	A	1544
1482 FORWARD_CMDTBL	A	1454
1446 FORWARD_CMD_CK	A	1256
1451 FORWARD_COME	A	1448
1476 FORWARD_JUMP	A	1494
1858 FREQ_CAL	A	1847,1853
1843 FREQ_CALC	A	470
145 FROM_OBF_BF	A	1141,1144,1150,1153,1167,1170,1931,1934,1954
1141 HAJIMEI	A	1143,1147
1139 HAJIMERUYO	A	551
568 HDLC_TX_START	A	1696
170 HISTORY_BUFFER	A	459,735,824
952 HON	A	
1150 HONBAN1	A	1152,1156
127 HSB_LED	A	
782 IBF_1ST	A	
828 IBF_2ND	A	780
785 IBF_EMPTY	A	
790 IBF_EXIST	A	783
774 IBF_INTERRUPT	A	
825 IBF_MEMO	A	823
58 IBF_OVER_FLOW	A	
803 IBF_PACKET	A	799
840 IBF_RET	A	788,826,834
830 IBF_SET	A	
101 IC_BYTE	A	1333,1377,1467,1656
IC_DROP_DEVICE	E	1388,1470,1657,2058
103 ID_BYTE	A	1164,1180,1951,1960,2007,2024,2034
ID_DROP_DEVICE	E	1165,1335,1952,2026,2057
169 INDEX_HISTORY	A	460,724,736,803,825
82 INDEX_RX_1	A	427,1676
86 INDEX_RX_2	A	441,742,753
83 INDEX_TX_1	A	428,776,796,831
87 INDEX_TX_2	A	440
1773 INIT_AUTHO_TBL	A	463
1833 INIT_CODE	A	465
1835 INIT_CODE_LP	A	1838
1747 INIT_EV_1	A	1750
1745 INIT_EV_TIMER	A	473
1761 INIT_JUMP_LP	A	1764
1755 INIT_JUMP_TBL	A	515
95 INIT_POINT	A	1758
1737 INIT_TIM_LP	A	1740
1735 INIT_TIM_TBL	A	514
1792 INIT_VIEW_LP	A	1799
1790 INIT_VIEW_TBL	A	464
1757 INIT_WA_DOKO	A	1755
235 INT10FST	A	288
236 INT30FST	A	292
234 INT_OFST	A	296
75 JUMP_ADDRESS	A	1759
JUMP_ADRS_INIT	E	1989,2015,2076
JUMP_ADRS_INIZ	E	1980,1988,2077

## CROSS REFERENCE TABLE

LINE#	SYMBOL	TYPE	REFERENCES
1782	JUN	A	1785
1775	JUNKO	A	1778
1271	KEY_APPLICAT	A	1258
130	KEY_DATA	A	1387, 1469, 1997, 2030
160	KEY_DATA_STACK	A	161
1993	KEY_DEPRESS	A	1971
	KEY_OPERATION	E	1271, 1472, 2065
205	KEY_PUSH_CODE	A	1996
	LED_VIEW_TBL	E	1664, 2069
	LOAD_FROM_DROP	E	1142, 1151, 1168, 1932, 2054
	LOAD_TO_DROP	E	1650, 2055
873	LOY	A	868
876	LOZ	A	871, 875
1812	LP1	A	1816
1821	LP2	A	1827
125	LSB_LED	A	
1256	MAIN_LOOP	A	1272, 1279
424	MAIN_START	A	
197	MINUS_KEY_CODE	A	
1371	MOV_1_INIT	A	1364
1363	MOV_1_ST	A	1354
1356	MOV_2_NO	A	
126	MSB_LED	A	
1871	MULTI	A	1896, 1899
108	MUL_ADR	A	1843, 1871
191	MUL_NO	A	1843
1016	MY_ADRS	A	1000, 1002
1014	MY_ALOHA	A	
76	NEXT_GO_ADPS	A	
121	NOW_EVENT	A	1311, 1331
1580	NO_SEND	A	1568
116	OBF_BF_BYTE	A	
114	OBF_BF_CMD	A	453, 756
115	OBF_BF_ID	A	
113	OBF_BF_N	A	114, 115, 116, 117, 446, 688, 689, 690, 755
679	OBF_INTERRUPT	A	
736	OBF_MEMO	A	734
755	OBF_NEW	A	740
722	OBF_PACKET	A	
739	OBF_RET	A	700, 712, 720
700	OBF_RET_1	A	703
131	ONE_SEC_TIMER	A	457
196	ONOFF_KEY_CODE	A	
	OP_INITIAL	E	1756, 2074
	OP_SPU_OFF	E	1670, 2073
175	PAGE_MEM	A	450, 733, 822
90	PAGE_SM	A	451, 950, 996, 1020
	PAY_GROUP_1	E	1490, 2080
	PAY_GROUP_2	E	1492, 2081
61	PC_CODE	A	1833
137	PC_FC_EXIST	A	
65	PC_FC_LIST	A	1773
193	PLUS_KEY_CODE	A	
1223	POLLING_SEQ	A	1216
222	POP_ALL	A	
	POWER_DET_CMD	E	1140, 1149, 2053
138	POWER_FEED	A	432

## CROSS REFERENCE TABLE

	SYMBOL	TYPE	REFERENCES
202	POWER_OFF_CODE	A	
201	POWER_ON_CODE	A	
128	PPV_LED	A	
55	PROGRAMVERSION	A	503,517
221	PUSH_ALL	A	
276	RAM_CLEAR	A	
278	RAM_CLEAR_LP	A	281
1972	RECENT_ON	A	
203	RECENT_ON_CODE	A	
204	RELEASE_CODE	A	
702	RESPONSE_2	A	694
719	RESPONSE_CHK	A	697,699,709,716
745	RESPONSE_TPNS	A	730
711	RESPONSE_VAL	A	707
2044	RESP_84_MRET	A	2021
1969	RESP_STATUS	A	1966
2004	RESP_VLF_ERR	A	1957
1415	RETTIM2	A	1407
92	REVERS_CHANEL	A	448,575,1572,1585
252	RUN	A	1464
	RUN_CONVERTER	E	1346,1666,2071
1038	RX_CRC_ERR	A	993
56	RX_CRC_ERROR	A	1038,1039
57	RX_CRC_OK_YO	A	994,995
990	RX_INTERRUPT	A	
992	RX_RCV	A	
1042	RX_RECEIVE	A	992
1022	RX_RET	A	1004,1009,1040
198	SCAN_KEY_CODE	A	
59	SCAN_MODE_FLAG	A	467
5	SEISAKU_DD	A	520
6	SEISAKU_MM	A	519
8	SEISAKU_VV	A	521
7	SEISAKU_YY	A	518
148	SEND_ADDRESS	A	149,150,151,1575
150	SEND_CMD_RESP	A	1570
151	SEND_DATA_BUFF	A	
147	SEND_ENABLE	A	148,1559
1552	SEND_FUNC_MOD	A	1486
149	SEND_INDEX	A	1563,1566,1573,1574
200	SEND_KEY_CODE	A	
224	SEND_MAX	A	
1566	SEND_RESPONSE	A	1488
2043	SENS_STATUS	A	2039
561	SETCOM	A	347,351,355,359,363,367,374,378,382,540
1675	SPECIAL_SPU_1	A	2049
	SPU_CLEAR_DISP	E	1205,2062
144	SPU_CMD_BF	A	
	SPU_LED_DISP	E	1665,2070
	SPU_RELAY_OFF	E	1204,2061
	SPU_STATUS_REQ	E	1166,2043,2056
177	STACK_END	A	
178	STACK_TOP	A	
1619	STORE_MEMORY	A	1548
1635	STOR_MEM_5517	A	1626
1627	ST_TRNS2	A	1632
1639	ST_TRNS3	A	1637,1644

## CROSS REFERENCE TABLE

SYMBOL	TYPE	REFERENCES
1562 S_F_M_CLR	A	1555
1558 S_F_M_SET	A	1553
110 TEMP_R_CN	A	429, 576, 605, 1096
237 TIMER1_OFST	A	304
1391 TIMER_ACTIVE	A	
1403 TIMER_CHK	A	1292
168 TIMER_COUNTER	A	500, 738, 819, 1297, 1301, 1348
1292 TIMER_OPEPAT	A	1257
192 TIMER_OUT_CODE	A	1386
1396 TIMER_SLEEP	A	1382, 1394
1376 TIMER_TOB	A	1352, 1358, 1361, 1369, 1373
1381 TIMER_TOB2	A	
1340 TIMER_TYPE_2	A	1303, 1306, 1312, 1326, 1329
1297 TIMER_YO	A	1293
74 TIME_TABLE	A	1379, 1735
79 TO_CCC	A	439
78 TO_DROP	A	426
134 TUNER_CBL	A	
132 TUNER_D1	A	
133 TUNER_D2	A	
164 TX_BUFFER	A	1596
93 TX_BUSY_FLAG	A	430, 921, 1109, 1685, 1695
1782 TX_CCC_M_RET	A	1449, 1462, 1494, 1496, 1498, 1500, 1502, 1504, 1506, 1508, 1510, 1512, 1514, 1516, 1518, 1520, 1522, 1524, 1526, 1528, 1530
1685 TX_CCC_RUN	A	1532, 1534, 1536, 1538, 1540, 1556, 1560, 1564, 1580, 1633, 1638, 1645, 1651, 1668, 1671, 1687
163 TX_COMMAND	A	1578, 1588, 1607, 1617
162 TX_LENGTH	A	1594, 1621
1689 TX_RUN_SUB	A	1597, 1624, 1675
1688 TX_TRNS2	A	1605, 1681
1615 TX_TRNS3	A	1615
898 TX_UNDRN	A	
1693 TX_YDSH1	A	1693
1981 UP64	A	1861
1862 UP64_D	A	1902
135 UP_FLAG	A	
60 VIEW_CHANNEL	A	1790
64 VLF_ERROR_MAP	A	1958, 2005, 2032
2016 VLF_ERR_RET	A	2014
643 WAIT	A	594, 595, 596, 597, 598, 599, 600, 601, 635
646 WAIT1	A	648
MAKEARI_DE_ON	E	1667, 2072
1569 YES_SEND	A	
1892 ZERO	A	1863, 1865

**SOURCE LINE**

```

1 '0086'
2 ;
3 ;*****
4 ;
5 SEISAKU_DD: EQU 02H ;
6 SEISAKU_MM: EQU 12M ;
7 SEISAKU_YY: EQU 58M ;
8 SEISAKU_VV: EQU 2 ; Version No.
9 *****
10 <<< Application >>>
11 *****
12 *****
13 ***** ----- Bu M.TANAKA -----
14 *****
15 Function
16 (1) --- SPU Key Control
17 6 Drop / 4 SPU ( 2nd Subscriber )
18 *****
19 (2) --- Ram Back up
20 *****
21 (3) --- Hardware Check
22 *****
23 Off Event Conv , SW , Device No. (3 Degt)
24 Off Send Revrese Data Send
25 Event Event LED On
26 *****
27 *****
28 *****
29 *****
30 *****
31 *****
32 *****
33 *****
34 $$$$$$
35 <<< Bug List >>>
36 $$$$$$
37 (1) 2< 2nd Sub. de Converter On/Off ga okashii
38 $$$$$$
39 $$$$$$
40 $$$$$$
41 $$$$$$
42 $$$$$$
43
44
45 ;
46 BIAS: EQU 0000H
47 ;
48
49 PROGRAMVERSION: EQU BIAS ; DS 4
50 RX_CRC_ERROR: EQU BIAS+4 ; DS 4
51 RX_CRC_OK_YO: EQU BIAS+8 ; DS 4
52 IBF_OVER_FLOW: EQU BIAS+12 ; DS 2
53 SCAN_MODE_FLAG: EQU BIAS+14 ; DS 1
54 VIEW_CHANNEL: EQU BIAS+16 ; DS 8*2
55 PC_CODE: EQU BIAS+32 ; DS 8*2
56 EVENT_CHANNEL EQU BIAS+48 ; DS 8
57 ; EQU BIAS+56

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

58 VLF_ERROR_MAP: EQU BIAS+128          ; DS 128
59 PC_FC_LIST:    EQU BIAS+256          ; DS 128
60 BASIC_AUTHD:    EQU BIAS+256+128      ; DS 128
61                ; BIAS+512
62
63
64
65 ;
66 A200H:          EQU 200H
67 CH_NO_FREQ:     EQU A200H            ; DS 256   FREQUENCY TABLE START FROM HERE
68 TIME_TABLE:     EQU A200H+100H        ; 8*8*2
69 JUMP_ADDRESS:   EQU A200H+180H        ; 8*8*2
70 NEXT_GO_ADRS:   EQU A200H+200H        ; 64*2
71                ; --- 480H
72 TO_DROP:        EQU 0500H
73 TO_CCC:         EQU 0600H
74 ;
75 DS2:            EQU 0700H
76 INDEX_RX_1:     EQU DS2+2*1
77 INDEX_TX_1:     EQU DS2+2*2
78 CTRL_1:         EQU DS2+2*3
79 CTRL_1_COUNT:   EQU DS2+2*4
80 INDEX_RX_2:     EQU DS2+2*5
81 INDEX_TX_2:     EQU DS2+2*6
82 CTRL_2:         EQU DS2+2*7
83 CTRL_2_COUNT:   EQU DS2+2*8
84 PAGE_SW:        EQU DS2+2*9
85 ECHO_BACK_FLAG: EQU DS2+2*10
86 REVERS_CHANEL:  EQU DS2+2*11
87 TX_BUSY_FLAG:   EQU DS2+2*12
88 BASE_POINT:     EQU DS2+2*13
89 INIT_POINT:     EQU DS2+2*14
90 BINARY_LED:     EQU DS2+2*15
91 ECHO_BACK_ADRS: EQU DS2+2*16
92
93 CONV_NO:        EQU DS2+2*18
94 DROP_NO:        EQU DS2+2*19
95 IC_BYTE:        EQU DS2+2*20
96 DEVICE_NO:      EQU DS2+2*21
97 ID_BYTE:        EQU DS2+2*22
98 CONV_NO_BIT:    EQU DS2+2*23
99 DROP_NO_BIT:    EQU DS2+2*24
100 DEVICE_NO_BIT: EQU DS2+2*25
101
102 MUL_ADR:        EQU DS2+2*29          ; DS 2   STORE #3
103 EXTRN_STAT:     EQU DS2+2*30          ; DS 2
104 TEMP_R_CM:      EQU DS2+2*31          ; DS 2
105
106 ;                740H
107 OBF_BF_N:       EQU DS2+2*32          ; 0000 0000
108 OBF_BF_CMD:     EQU OBF_BF_N+1
109 OBF_BF_ID:      EQU OBF_BF_N+2
110 OBF_BF_BYTE:    EQU OBF_BF_N+3
111 CONV_SELECT:    EQU OBF_BF_N+16      ; DS 8
112
113 ;
114 DS1:            EQU 0780H

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

115 NOW_EVENT:      EQU DS1
116 BEFOR_EVENT:    EQU DS1+1
117 EVENT_ENABLE:   EQU DS1+2
118
119 LSB_LED:         EQU DS1+4
120 MSB_LED:         EQU DS1+5
121 HSB_LED:         EQU DS1+6
122 PPV_LED:         EQU DS1+7
123
124 KEY_DATA:        EQU DS1+9
125 ONE_SEC_TIMER:   EQU DS1+10
126 TUNER_D1:        EQU DS1+11
127 TUNER_D2:        EQU DS1+12
128 TUNER_CBL:       EQU DS1+13
129 UP_FLAG:         EQU DS1+14
130 DOWN_FLAG:       EQU DS1+15
131 PC_PC_EXIST:     EQU DS1+16
132 POWER_FEED:      EQU DS1+17
133 ;
134
135
136 DS16:             EQU 800H
137 DROP_CMD_BF:      EQU DS16                      ; DS 16
138 SPU_CMD_BF:       EQU DS16+16*1                  ; DS 16
139 FROM_OBF_BF:      EQU DS16+16*2                  ; DS 16
140
141 SEND_ENABLE:       EQU DS16+16*3                  ; DS 1
142 SEND_ADDRESS:     EQU SEND_ENABLE+1              ; DS 2
143 SEND_INDEX:        EQU SEND_ADDRESS+2             ; DS 1
144 SEND_CMD_RESP:     EQU SEND_ADDRESS+3             ; DS 1
145 SEND_DATA_BUFF:    EQU SEND_ADDRESS+4             ; DS 123
146
147 EVENT_NO_FREQ:     EQU 900H                      ; DS 256
148
149
150 HELP:              EQU 0A00H
151 ;
152 ;-----
153 ;
154 KEY_DATA_STACK:    EQU 1000H                      ; DS 16*64=1024
155 ECU_ADDRESS:        EQU KEY_DATA_STACK+16*64      ; DS 2
156 TX_LENGTH:         EQU ECU_ADDRESS+2             ; DS 1
157 TX_COMMAND:        EQU ECU_ADDRESS+3             ; DS 1
158 TX_BUFFER:         EQU ECU_ADDRESS+4             ; DS 256
159
160
161 ;
162 TIMER_COUNTER:     EQU 2000H-4
163 INDEX_HISTORY:     EQU 2000H-2
164 HISTORY_BUFFER:    EQU 2000H
165
166
167
168 ;
169 PAGE_MEM:          EQU 3000H
170
171 STACK_END:         EQU 39FFH

```



HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

172 STACK_TOP:      EQU 4000H
173 ;
174 ; ***** BACK_UP RAM Area *****
175 ;
176 ES_BACK_UP:      EQU 0          ; DS 512
177 ES_BACK_UP_1:    EQU 200H      ; DS 512
178 ES_BACK_UP_2:    EQU 400H      ; DS 512
179 ;
180 ES_EVENT_TIMER:   EQU 600H      ; DS 128*6
181 ;
182 ;
183 ; ***** Immediate Data *****
184 ;
185 MUL_NO           EQU          3
186 TIMER_OUT_CODE:  EQU 0
187 PLUS_KEY_CODE:   EQU 10H
188 EVENT_KEY_CODE:  EQU 11H
189 AUTHO_KEY_CODE:  EQU 12H
190 ONOFF_KEY_CODE:  EQU 13H
191 MINUS_KEY_CODE:  EQU 14H
192 SCAN_KEY_CODE:   EQU 15H
193 CLEAR_KEY_CODE:  EQU 16H
194 SEND_KEY_CODE:   EQU 17H
195 POWER_ON_CODE:   EQU 18H
196 POWER_OFF_CODE:  EQU 19H
197 RECENT_ON_CODE:  EQU 1AH
198 RELEASE_CODE:    EQU 1BH
199 KEY_PUSH_CODE:   EQU 1CH
200 ;
201 ASCII_ER:        EQU 4572H
202 ASCII_AU:        EQU 4155H
203 ASCII_SC:        EQU 5343H
204 ASCII_FC:        EQU 4643H
205 ASCII_PC:        EQU 5043H
206 ASCII_CL:        EQU 434CH
207 ASCII_SE:        EQU 5345H
208 ASCII_AD:        EQU 4164H
209 ASCII_DE:        EQU 6445H
210 ASCII_HU:        EQU 0D49CH
211 ASCII_NO:        EQU 0D4DCH
212 ASCII_CO:        EQU 43DCH
213 ASCII_PR:        EQU 5072H
214 ;
215 PUSH_ALL:        EQU 60H
216 POP_ALL:         EQU 61H
217 ;
218 SEND_MAX:        EQU 64*2
219 ;
220 ; -----
221 ; ***** I / O Port *****
222 ; -----
223 ;
224 DROP_CMD_PORT:   EQU 082H
225 DROP_DATA_PORT: EQU 080H
226 ECU_H_ADDRESS:   EQU 0102H
227 ECU_L_ADDRESS:   EQU 0100H
228 INT_OFST        EQU          0A0H+(5*4)

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

229 INT10FST      EQU          52
230 INT30FST      EQU          59
231 TIMEP1_OFST   EQU          72
232 ACHD          EQU          06
233 ACHC          EQU          04
234 BCHD          EQU          02
235 BCHC          EQU          05
236
237
238              ORG 1000H
239
240
241 :
1000 BE8003      242 JUMP_ADRS_INIT: MOV SI, JUMP_ADDRESS
1003 B700        243             MOV BH, 0
1005 8A1E2C07    244             MOV BL, [IC_BYTE]
1009 02DB        245             ADD BL, BL
100B 8B0E1C07    246             MOV CX, [INIT_POINT]
100F 8908        247             MOV [SI][BX], CX
1011 C3          248             RET
                249 ;
                250 :
1012 BE8003      251 JUMP_ADRS_INIT: MOV SI, JUMP_ADDRESS
1015 B700        252             MOV BH, 0
1017 8A1E2807    253             MOV BL, [IC_BYTE]
101B 02DB        254             ADD BL, BL
101D 8B0E1C07    255             MOV CX, [INIT_POINT]
1021 8908        256             MOV [SI][BX], CX
1023 C3          257             RET
                258 ;
                259 :
1024 BE8003      260 JUMP_ADRS_INIT: MOV SI, JUMP_ADDRESS
1027 B700        261             MOV BH, 0
1029 8A1E2C07    262             MOV BL, [IC_BYTE]
102D 80F301      263             XOR BL, 1
1030 02DB        264             ADD BL, BL
1032 8B0E1C07    265             MOV CX, [INIT_POINT]
1036 8908        266             MOV [SI][BX], CX
1038 C3          267             RET
268 ; ***** Converter ---- Drop ni hantun *****
1039 56          269 CONV_TO_DROP: PUSH SI
103A E84E00      270             CALL CONV_SW_BIT_ML
103D 2204        271             AND AL, [SI]
103F 7418        272             JZ HIROKO
1041 8A262807    273             MOV AH, [IC_BYTE]
1045 80E4FE      274             AND AH, 0FEH
1048 88262C07    275             MOV [ID_BYTE], AH
104C 8A262407    276             MOV AH, [CONV_NO]
1050 80E406      277             AND AH, 06H
1053 88262607    278             MOV [DROP_NO], AH
1057 5E          279             POP SI
1058 C3          280             RET
1059 8A262807    281 HIROKO:      MOV AH, [IC_BYTE]
105D 88262C07    282             MOV [ID_BYTE], AH
1061 8A262407    283             MOV AH, [CONV_NO]
1065 88262607    284             MOV [DROP_NO], AH
1069 5E          285             POP SI

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

106A C3      286      RET
              287 ;
              288 ;
106B 56      289 DROP_TO_CONV:  PUSH SI
106C E81C00  290      CALL CONV_SW_BIT_AL
106F 2204    291      AND AL,[SI]
1071 7402    292      JZ HIROYO
1073 8001    293      MOV AL,1
1075 8A262C07 294 HIROYO:    MOV AH,[ID_BYTE]
1079 0AE0    295      OR AH,AL
107B 88262807 296      MOV [IC_BYTE],AH
107F 8A262607 297      MOV AH,[DROP_NO]
1083 0AE0    298      OR AH,AL
1085 88262407 299      MOV [CONV_NO],AH
1089 5E      300      POP SI
109A C3      301      RET
              302 ;
              303 ;
108B BE5007  304 CONV_SW_BIT_AL:  MOV SI,CONV_SELECT
108E B500    305      MOV CH,0
1090 8A0E2607 306      MOV CL,[DROP_NO]
1094 03F1    307      ADD SI,CX
1096 E88505  308      CALL DEVICE_BIT_AL
1099 C3      309      RET
              310 ;
109A 50      311 CONV_SW_FLAG:  PUSH AX
109B 31      312      PUSH CX
109C 56      313      PUSH SI
109D EBEBFF  314      CALL CONV_SW_BIT_AL
10A0 2204    315      AND AL,[SI]
10A2 5E      316      POP SI
10A3 59      317      POP CX
10A4 58      318      POP AX
10A5 C3      319      RET
              320 ;
              321 ; ***** ID_BYTE ---> DROP_NO , DEVICE_NO *****
              322 ;
10A6 50      323 ID_DROP_DEVICE:  PUSH AX
10A7 51      324      PUSH CX
10A8 8A262C07 325      MOV AH,[ID_BYTE]
10AC 8AC4    326      MOV AL,AH
10AE 80E407  327      AND AH,7
10B1 88262607 328      MOV [DROP_NO],AH
10B5 B103    329      MOV CL,3
10B7 D2C8    330      ROR AL,CL
10B9 2407    331      AND AL,7
10BB A22A07  332      MOV [DEVICE_NO],AL
              333 ;
10BE E91800  334      JMP MAKE_DATA
              335 ;
              336 ; ***** IC_BYTE ---> CONV_NO , DEVICE_NO *****
              337 ;
10C1 50      338 IC_DROP_DEVICE:  PUSH AX
10C2 51      339      PUSH CX
10C3 8A262807 340      MOV AH,[IC_BYTE]
10C7 8AC4    341      MOV AL,AH
10C9 80E407  342      AND AH,7

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

10CC 88262407      343      MOV [CONV_NO],AH
10DD 8103          344      MOV CL,3           : A4 A3 A2 A1  A0 D2 D1 D0
10DE D2C8         345      ROR AL,CL           : - - - A4  A3 A2 A1 A0
10DF 2407         346      AND AL,7           : 0 0 0 A4  A3 A2 A1 A0
10E6 A22A07       347      MOV [DEVICE_NO],AL
10E7             348 ;
10E9 8001         349 MAKE_DATA:  MOV AL,1
10DB 8A0E2407     350      MOV CL,[CONV_NO]
10DF D2C0         351      ROL AL,CL
10E1 A22E07       352      MOV [CONV_NO_BIT],AL
10E2             353 ;
10E4 8001         354      MOV AL,1
10E6 8A0E2607     355      MOV CL,[DROP_NO]
10EA D2C0         356      ROL AL,CL
10EC A23007       357      MOV [DROP_NO_BIT],AL
10ED             358 ;
10EF 8001         359      MOV AL,1
10F1 8A0E2A07     360      MOV CL,[DEVICE_NO]
10F5 D2C0         361      ROL AL,CL
10F7 A23207       362      MOV [DEVICE_NO_BIT],AL
10F8             363 ;
10FA 59          364      POP CX
10FB 58          365      POP AX
10FC C3          366      RET
10FD             367 ;
10FD             368 ; ***** TO_DROP Buffer Space ? *****
10FD             369 ;
10FD A00607       370 TO_DROP_SPACE:  MOV AL,[CTRL_1]
1100 3C28         371      CMP AL,40
1102 F5          372      CMC
1103 C3          373      RET
1104             374 ;
1104             375 ; ***** AL Wa Souji Kai ? *****
1104             376 ;
1104 3C30         377 KAZUKO:      CMP AL,30H
1106 7203         378      JC KAZUKO_RET
1108 3C3A         379      CMP AL,3AH
110A F5          380      CMC
110B C3          381 KAZUKO_RET:  RET
110C             382 ;
110C             383 ; ***** TO_DROP Buffer ni ireru *****
110C             384 ;
110C E8EEFF       385 LOAD_TO_DROP:  CALL TO_DROP_SPACE ; Korenara Anzenne !!!!!!!!!!!
110F 721F         386      JC IBF_OVP
1110             387 ;
1111 8B1E0207     388      MOV BX,[INDEX_RX_1]
1113 8A0C         389      MOV CL,[SI]
1117 FEC1         390      INC CL
1119 8A24         391 LD1:      MOV AH,[SI]
111B 8827         392      MOV [BX],AH
111D FEC3         393      INC BL
111F 46          394      INC SI
1120 FEC9         395      DEC CL
1122 75F5         396      JNZ LD1
1124 FE060607     397      INC BYTE PTR [CTRL_1]
1128 891E0207     398      MOV [INDEX_RX_1],BX
112C E84705       399      CALL IBF_UNMASK

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

112F C3          400 RETN:          RET
1130 FF060C00    401 IBF_OVR:      INC WORD PTR [IBF_OVER_FLOW]
1134 C3          402          RET
                  403 ;
                  404 ; ***** TO_CCC Buffer Kara toridasu *****
                  405 ;
1135 A00E07      406 LOAD_FROM_DROP: MOV AL,[CTRL_2]
1138 3C01        407          CMP AL,1
113A 72F3        408          JC RETN
113C 881E0C07    409          MOV BX,[INDEX_TX_2]
1140 8A0F        410          MOV CL,[BX]
1142 FEC1        411          INC CL
1144 8A27        412 LD2:      MOV AH,[BX]
1146 8824        413          MOV [SI],AH
1148 FEC3        414          INC BL
114A 46          415          INC SI
114B FEC9        416          DEC CL
114D 75F5        417          JNZ LD2
114F FE0E0E07    418          DEC BYTE PTR [CTRL_2]
1153 891E0C07    419          MOV [INDEX_TX_2],BX
1157 FB          420          CLC
1158 C3          421          RET
                  422 ;
                  423 ; ***** DROP MAP Set *****
                  424 ;
1159 BE0008      425 DROP_MAP_SET: MOV SI,DROP_CMD_BF
115C C60405      426          MOV BYTE PTR [SI],5
115F C6440107    427          MOV BYTE PTR [SI+1],7
1163 C6440210    428          MOV BYTE PTR [SI+2],10H
1167 C6440332    429          MOV BYTE PTR [SI+3],32H
116B C6440454    430          MOV BYTE PTR [SI+4],54H
116F C64405F0    431          MOV BYTE PTR [SI+5],0F0H
1173 E896FF      432          CALL LOAD_TO_DROP
1176 C3          433          RET
                  434 ;
                  435 ; ***** Power Detect Command *****
                  436 ;
1177 BE0008      437 POWER_DET_CMD: MOV SI,DROP_CMD_BF
117A C60401      438          MOV BYTE PTR [SI],1
117D C6440101    439          MOV BYTE PTR [SI+1],1
1181 E889FF      440          CALL LOAD_TO_DROP
1184 C3          441          RET
                  442 ;
                  443 ; ***** Subscriber Power OFF Control *****
                  444 ;
1185 BE0008      445 CONV_P_OFF_CMD: MOV SI,DROP_CMD_BF
1188 C60402      446          MOV BYTE PTR [SI],2
118B C6440105    447          MOV BYTE PTR [SI+1],5
118F A02407      448          MOV AL,[CONV_NO]
1192 2407        449          AND AL,7
1194 884402      450          MOV BYTE PTR [SI+2],AL
1197 E872FF      451          CALL LOAD_TO_DROP
                  452 ;
119A A02E07      453          MOV AL,[CONV_NO_BIT]
119D 343F        454          XOR AL,3FH
119F 20680007    455          AND [NOW_EVENT],AL
11A3 C3          456          RET

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

457 ;
458 ; ***** Subscriber Power ON Control *****
459 ;
11A4 BE0008 460 CONY_P_ON_CMD: MOV SI,DROP_CMD_BF
11A7 C60402 461 MOV BYTE PTR [SI],2
11AA C6440105 462 MOV BYTE PTR [SI+1],5
11AE A08D07 463 MOV AL,[TUNER_CBL]
11B1 884402 464 MOV BYTE PTR [SI+2],AL
11D4 E855FF 465 CALL LOAD_TO_DROP
11B7 C3 466 RET
467 ;
468 ; ***** Select Subscriber Cable *****
469 ;
11B8 C3 470 CABLE_SEL_CMD: RET
11B9 BE0008 471 MOV SI,DROP_CMD_BF
11BC C60402 472 MOV BYTE PTR [SI],2
11BF C6440106 473 MOV BYTE PTR [SI+1],6
11C3 A08D07 474 MOV AL,[TUNER_CBL]
11C6 247F 475 AND AL,7FH
11C8 884402 476 MOV BYTE PTR [SI+2],AL
11CB E83EFF 477 CALL LOAD_TO_DROP
11CE C3 478 RET
479 ;
480 ; ***** Tuner Frequency Change Request *****
481 ;
11CF BE0008 482 TUNER_FREQ_CMD: MOV SI,DROP_CMD_BF
11D2 C60404 483 MOV BYTE PTR [SI],4
11D5 C6440103 484 MOV BYTE PTR [SI+1],3
11D9 A02407 485 MOV AL,[CONV_NO]
11DC 884402 486 MOV BYTE PTR [SI+2],AL
11DF A08B07 487 MOV AL,[TUNER_D1]
11E2 884403 488 MOV BYTE PTR [SI+3],AL
11E5 A08C07 489 MOV AL,[TUNER_D2]
11E8 884404 490 MOV BYTE PTR [SI+4],AL
11EB E81EFF 491 CALL LOAD_TO_DROP
11EE C3 492 RET
493 ;
494 ; ***** Converter No Upokasu Program *****
495 ;
496 ;
11EF 50 497 RUN_CONVERTER: PUSH AX
11F0 53 498 PUSH BX
11F1 56 499 PUSH SI
500 ;
11F2 A02C07 501 MOV AL,[ID_BYTE]
11F5 50 502 PUSH AX
503 ;
11F6 E8AF00 504 CALL GO_CONVERTER
505 ;
11F9 BE8003 506 MOV SI,JUMP_ADDRESS
11FC B700 507 MOV BH,0
11FE 8A1E2607 508 MOV BL,[DROP_NO]
1202 80C310 509 ADD BL,10H
1205 8AF3 510 MOV DH,BL
1207 02DB 511 ADD BL,BL
1209 03DE 512 ADD BX,SI
120B 8202 513 MOV DL,2

```

; DH = First ID\_BYTE

; BX = First SPU JUMP\_ADDRESS

; DL = First SPU No.

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

120D E88AFE      514      CALL CONV_SW_FLAG
1210 7520        515      JNZ CONV1_VIEW_CHK
                  516 ;
                  517 ;
1212 88362C07    518 CONV0_VIEW_CHK: MOV [ID_BYTE],DH
1216 88162A07    519      MOV [DEVICE_NO],DL
121A E87DFE      520      CALL CONV_SW_FLAG
121D 7503        521      JNZ CONV0_NEXT
                  522 ;
121F E84000      523      CALL CONV_SUB
                  524 ;
1222 83C310      525 CONV0_NEXT:  ADD BX,10H      ; JUMP_ADDRESS
1225 80C608      526      ADD DH,8        ; ID_BYTE
1228 FEC2        527      INC DL          ; CONV_NO
122A 80FA06      528      CMP DL,6
122D 75E3        529      JNZ CONV0_VIEW_CHK
122F E91D00      530      JMP CONV_OP_END
                  531 ;
1232 88362C07    532 CONV1_VIEW_CHK: MOV [ID_BYTE],DH
1236 88162A07    533      MOV [DEVICE_NO],DL
123A E85DFE      534      CALL CONV_SW_FLAG
123D 7403        535      JZ CONV1_NEXT
                  536 ;
123F E82000      537      CALL CONV_SUB
                  538 ;
1242 83C310      539 CONV1_NEXT:  ADD BX,10H      ; JUMP_ADDRESS
1245 80C608      540      ADD DH,8        ; ID_BYTE
1248 FEC2        541      INC DL          ; CONV_NO
124A 80FA06      542      CMP DL,6
124D 75E3        543      JNZ CONV1_VIEW_CHK
                  544 ;
124F 5B          545 CONV_OP_END: POP AX
1250 A22C07      546      MOV [ID_BYTE],AL
1253 E850FE      547      CALL ID_DROP_DEVICE
1256 A08007      548      MOV AL,[NOW_EVENT]
1259 243F        549      AND AL,3FH
125B A28107      550      MOV [BEFOR_EVENT],AL
                  551 ;
125E 5E          552      POP SI
125F 5B          553      POP BX
1260 58          554      POP AX
1261 C3          555      RET
                  556 ;
1262 8B0F        557 CONV_SUB:  MOV CX,[BX]
1264 3B0E1C07    558      CMP CX,[INIT_POINT]
1268 743D        559      JZ AKEMI
126A 53          560      PUSH BX
126B 52          561      PUSH DX
                  562 ;
126C 8A268007    563      MOV AH,[NOW_EVENT]
1270 F6C4C0      564      TEST AH,0C0H
1273 750E        565      JNZ AYA0
1275 32268107    566      XOR AH,[BEFOR_EVENT]
1279 84262E07    567      TEST AH,[CONV_NO_BIT]
127D 741D        568      JZ MODE_SAME
127F 8A268007    569      MOV AH,[NOW_EVENT]
1283 F6C480      570 AYA0:  TEST AH,80H

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1286 7411      571      JZ AYA3
1288 F6C440    572      TEST AH,40H
1288 7406      573      JZ AYA2
128D E88801    574 AYA1:  CALL EVENT_LED_NRM
1290 E90900    575      JMP MODE_SAME
                    576 ;
1293 E8D901    577 AYA2:  CALL EVENT_LED_FLH
1296 E90300    578      JMP MODE_SAME
                    579 ;
1299 E88701    580 AYA3:  CALL EVENT_LED_OFF
                    581 ;
129C 3B0E1A07  582 MODE_SAME: CMP CX,[BASE_POINT]
12A0 7503      583      JNZ AKINA
12A2 E80602    584      CALL SPU_LED_DISP
12A5 5A        585 AKINA:  POP DX
12A6 5B        586      POP BX
                    587 ;
12A7 C3        588 AKEN1:  RET
                    589 ;
12A8 8A3E8507  590 GO_CONVERTER: MOV BH,[MSB_LED]
12AC 8A1E8407  591      MOV BL,[LSB_LED]
12D0 E8EB03    592      CALL DECBIN_BX
12B3 BE0009    593 :      ***** EVENT Program Tailor *****
12B6 A08007    594      MOV SI,EVENT_NO_FREQ
12B9 84062E07  595      MOV AL,[NOW_EVENT]
12BD 7503      596      TEST AL,[CONV_NO_BIT]
12BF BE0002    597      JNZ CONV_EVENT
12C2 03F3      598      MOV SI,CH_NO_FREQ
12C4 8A00      599 CONV_EVENT: ADD SI,BX
12C6 A28B07    600 ;
12C9 8A6001    601      MOV AL,[SI][BX]
12CC 8B268C07  602      MOV [TUNER_D1],AL
12D0 D0C4      603      MOV AH,[SI][BX+1]
12D2 80E440    604      MOV [TUNER_D2],AH
12D5 80CC80    605      ROL AH
12D8 0A262407  606      AND AH,40H
12DC 8B268D07  607      OR AH,80H
12E0 E8C1FE    608      OR AH,[CONV_NO]
12E3 E8D2FE    609      MOV [TUNER_CBL],AH
12E6 E8E6FE    610      CALL CONV_P_ON_CMD
12E9 C3        611      CALL CABLE_SEL_CMD
12EA BE8003    612      CALL TUNER_FREQ_CMD
12ED 8700      613      RET
12EF 8A1E2607  614 ;
12F3 80C310    615 ;
12F6 8AF3      616 ;
12F8 02DB      617 STP_CONVERTER: MOV SI,JUMP_ADDRESS
12FA 03DE      618      MOV BH,0
12FC 8202      619      MOV BL,[DROP_NO]
12FE E899FD    620      ADD BL,10H
1301 7525      621      MOV DH,BL
                    622      ADD BL,BL
                    623      ADD BX,SI
                    624      MOV DL,2
                    625      CALL CONV_SW_FLAG
                    626      JNZ CONV1_STP_CHK
                    627 ;

```

; DH = First ID\_BYTE

; BX = First SPU JUMP\_ADDRESS

; DL = First SPU No.



HEWLETT-PACKARD: 3086 Assembler

## SOURCE LINE

```

1303 88362C07      628 ;
1307 88162A07      629 CONV0_STP_CHK:  MOV [ID_BYTE],DH
1308 E88CFD        630                      MOV [DEVICE_NO],DL
130E 7508          631                      CALL CONV_SM_FLAG
1310 880E1C07      632                      JNZ STPC0_NEXT
1314 390F          633                      MOV CX,[INIT_POINT]
1316 7534          634                      CMP [BX],CX
1318 83C310        635                      JNZ CONV_VIEW_YET
131B 80C608        636 STPC0_NEXT:    ADD BX,10H          ; JUMP_ADDRESS
131E FEC2          637                      ADD DH,8            ; ID_BYTE
1320 80FA06        638                      INC DL            ; CONV_NO
1323 75DE          639                      CMP DL,6
1325 E92200        640                      JNZ CONV0_STP_CHK
1326              641                      JMP CONV_VIEW_STP
1327              642 ;
1328 88362C07      643 CONV1_STP_CHK:  MOV [ID_BYTE],DH
132C 88162A07      644                      MOV [DEVICE_NO],DL
1330 E867FD        645                      CALL CONV_SM_FLAG
1333 7408          646                      JZ STPC1_NEXT
1335 880E1C07      647                      MOV CX,[INIT_POINT]
1339 390F          648                      CMP [BX],CX
133B 750F          649                      JNZ CONV_VIEW_YET
133D 83C310        650 STPC1_NEXT:    ADD BX,10H          ; JUMP_ADDRESS
1340 80C608        651                      ADD DH,8            ; ID_BYTE
1343 FEC2          652                      INC DL            ; CONV_NO
1345 80FA06        653                      CMP DL,6
1348 75DE          654                      JNZ CONV1_STP_CHK
1349              655 ;
134A F8            656 CONV_VIEW_STP:  CLC
134B C3            657                      RET
134C              658 ;
134C F9/          659 CONV_VIEW_YET:  STC
134D C3            660                      RET
134E              661 ;
134E              662 ; ***** Device MAP Set *****
134E              663 ;
134E A02407        664 DEVICE_MAP_SET: MOV AL,[CONV_NO]
1351 BE0008        665                      MOV SI,DROP_CMD_BF
1354 C60407        666                      MOV BYTE PTR [SI],7
1357 C6440108      667                      MOV BYTE PTR [SI+1],8
135B 884402        668                      MOV BYTE PTR [SI+2],AL      ; Drop No. = AL
135E C6440332      669                      MOV BYTE PTR [SI+3],32H
1362 C6440454      670                      MOV BYTE PTR [SI+4],54H
1366 C64405FF      671                      MOV BYTE PTR [SI+5],0FFH
136A C64406FF      672                      MOV BYTE PTR [SI+6],0FFH
136E C64407F0      673                      MOV BYTE PTR [SI+7],0F0H
1372 E897FD        674                      CALL LOAD_TO_DROP
1375 C3            675                      RET
1376              676 ;
1376              677 ; ***** SPU Status Request Command Create *****
1376              678 ;
1376 BE1008        679 SPU_STATUS_REQ: MOV SI,SPU_CMD_RF
1379 C60404        680                      MOV BYTE PTR [SI],4          ; Length
137C C6440104      681                      MOV BYTE PTR [SI+1],4        ; Drop Command
1380 A02C07        682                      MOV AL,[ID_BYTE]
1383 884402        683                      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
1386 C6440301      684                      MOV BYTE PTR [SI+3],1        ; Byte Count

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

138A A02A07      685      MOV AL,[DEVICE_NO]
138D 884404      686      MOV BYTE PTR [SI+4],AL      ; Status Req. Command
1390 E879FD      687      CALL LOAD_TO_DROP
1393 C3          688      RET
                689 ;
                690 ; ***** Clear Device Display Command *****
                691 ;
* 1394 BE1008      692 SPU_CLEAR_DISP: MOV SI,SPU_CMD_BF
1397 C60404      693      MOV BYTE PTR [SI],4      ; Length
139A C6440104     694      MOV BYTE PTR [SI+1],4      ; Drop Command
139E A02C07      695      MOV AL,[ID_BYTE]
13A1 884402      696      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
13A4 C6440301     697      MOV BYTE PTR [SI+3],1      ; Byte Count
13A8 A02A07      698      MOV AL,[DEVICE_NO]
13AB 0C30        699      OR AL,30H
13AD 884404      700      MOV BYTE PTR [SI+4],AL      ; Clear Disp. Command
13D0 E859FD      701      CALL LOAD_TO_DROP
13B3 C3          702      RET
                703 ;
                704 ; ***** Relay Control ON Command *****
                705 ;
13B4 BE1008      706 SPU_RELAY_ON:  MOV SI,SPU_CMD_BF
13B7 C60405      707      MOV BYTE PTR [SI],5      ; Length
13BA C6440104     708      MOV BYTE PTR [SI+1],4      ; Drop Command
13BE A02C07      709      MOV AL,[ID_BYTE]
13C1 884402      710      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
13C4 C6440302     711      MOV BYTE PTR [SI+3],2      ; Byte Count
13C8 A02A07      712      MOV AL,[DEVICE_NO]
13CB 0C28        713      OR AL,28H
13CD 884404      714      MOV BYTE PTR [SI+4],AL      ; Relay Cont. Command
13D0 B0FF        715      MOV AL,0FFH
13D2 884405      716      MOV BYTE PTR [SI+5],AL      ; ON
13D5 E834FD      717      CALL LOAD_TO_DROP
13D8 C3          718      RET
                719 ;
                720 ; ***** Relay Control OFF Command *****
                721 ;
13D9 BE1008      722 SPU_RELAY_OFF: MOV SI,SPU_CMD_BF
13DC C60405      723      MOV BYTE PTR [SI],5      ; Length
13DF C6440104     724      MOV BYTE PTR [SI+1],4      ; Drop Command
13E3 A02C07      725      MOV AL,[ID_BYTE]
13E6 884402      726      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
13E9 C6440302     727      MOV BYTE PTR [SI+3],2      ; Byte Count
13ED A02A07      728      MOV AL,[DEVICE_NO]
13F0 0C28        729      OR AL,28H
13F2 884404      730      MOV BYTE PTR [SI+4],AL      ; Relay Cont. Command
13F5 B000        731      MOV AL,0
13F7 884405      732      MOV BYTE PTR [SI+5],AL      ; OFF
13FA E80FFD      733      CALL LOAD_TO_DROP
13FD C3          734      RET
                735 ;
                736 ; ***** Event LED ON Command *****
                737 ;
13FE BE1008      738 EVENT_LED_ON:  MOV SI,SPU_CMD_BF
1401 C60405      739      MOV BYTE PTR [SI],5      ; Length
1404 C6440104     740      MOV BYTE PTR [SI+1],4      ; Drop Command
1408 A02C07      741      MOV AL,[ID_BYTE]

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

140B 884402      742      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
140E C6440302    743      MOV BYTE PTR [SI+3],2      ; Byte Count
1412 A02A07      744      MOV AL,[DEVICE_NO]
1415 0C08        745      OR AL,8
1417 884404      746      MOV BYTE PTR [SI+4],AL      ; Event LED Cont. Command
141A 80FF        747      MOV AL,0FFH
141C 884405      748      MOV BYTE PTR [SI+5],AL      ;      ON
141F E8EAF0      749      CALL LOAD_TO_DROP
1422 C3          750      RET
                  751 ;
                  752 ; ***** Event LED OFF Command *****
                  753 ;
1423 BE1008      754 EVENT_LED_OFF: MOV SI,SPU_CMD_BF
1426 C60405      755      MOV BYTE PTR [SI],5      ; Length
1429 C6440104    756      MOV BYTE PTR [SI+1],4      ; Drop Command
142D A02C07      757      MOV AL,[ID_BYTE]
1430 884402      758      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
1433 C6440302    759      MOV BYTE PTR [SI+3],2      ; Byte Count
1437 A02A07      760      MOV AL,[DEVICE_NO]
143A 0C08        761      OR AL,8
143C 884404      762      MOV BYTE PTR [SI+4],AL      ; Event LED Cont. Command
143F 8000        763      MOV AL,0
1441 884405      764      MOV BYTE PTR [SI+5],AL      ;      OFF
1444 E8C5F0      765      CALL LOAD_TO_DROP
1447 C3          766      RET
                  767 ;
                  768 ; ***** Event LED Normal Command *****
                  769 ;
1448 E8B3FF      770 EVENT_LED_NRM: CALL EVENT_LED_ON
144B BE1008      771      MOV SI,SPU_CMD_BF
144E C60405      772      MOV BYTE PTR [SI],5      ; Length
1451 C6440104    773      MOV BYTE PTR [SI+1],4      ; Drop Command
1455 A02C07      774      MOV AL,[ID_BYTE]
1458 884402      775      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
145B C6440302    776      MOV BYTE PTR [SI+3],2      ; Byte Count
145F A02A07      777      MOV AL,[DEVICE_NO]
1462 0C10        778      OR AL,10H
1464 884404      779      MOV BYTE PTR [SI+4],AL      ; Event LED Mode Command
1467 C6440500    780      MOV BYTE PTR [SI+5],0      ;      Normal
146B E89EFC      781      CALL LOAD_TO_DROP
146E C3          782      RET
                  783 ;
                  784 ; ***** Event LED Flash Command *****
                  785 ;
146F E8B0FF      786 EVENT_LED_FLH: CALL EVENT_LED_ON
1472 BE1008      787      MOV SI,SPU_CMD_BF
1475 C60405      788      MOV BYTE PTR [SI],5      ; Length
1478 C6440104    789      MOV BYTE PTR [SI+1],4      ; Drop Command
147C A02C07      790      MOV AL,[ID_BYTE]
147F 884402      791      MOV BYTE PTR [SI+2],AL      ; ID_BYTE
1482 C6440302    792      MOV BYTE PTR [SI+3],2      ; Byte Count
1486 A02A07      793      MOV AL,[DEVICE_NO]
1489 0C10        794      OR AL,10H
148B 884404      795      MOV BYTE PTR [SI+4],AL      ; Event LED Mode Command
148E C64405FF    796      MOV BYTE PTR [SI+5],0FFH      ;      Flash
1492 E877FC      797      CALL LOAD_TO_DROP
1495 C3          798      RET

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

799 ;
800 ; ***** SPU View Channel Operation *****
801 ;
1496 BE1000 802 SPU_VIEW_DISP: MOV SI,VIEW_CHANNEL
1499 B700      803          MOV BH,0
149B 8A1E2407 804          MOV BL,[CONV_NO]
149F 8A20      805          MOV AH,[SI][BX]
14A1 8A4008    806          MOV AL,[SI][BX+8]
14A4 8B268507 807 SPU_LED_AX:  MOV [MSB_LED],AH
14AB A28407    808          MOV [LSB_LED],AL
809 ;
810 ; ***** SPU LED & EVENT_LED Operation *****
811 ;
14AB BE1008    812 SPU_LED_DISP: MOV SI,SPU_CMD_BF
14AE C60406    813          MOV BYTE PTR [SI],6          ; Length
14B1 C6440104 814          MOV BYTE PTR [SI+1],4      ; Drop Command
14B5 A02C07    815          MOV AL,[ID_BYTE]
14B8 8B4402    816          MOV BYTE PTR [SI+2],AL    ; Device/Drop
14BB C6440303 817          MOV BYTE PTR [SI+3],3      ; Byte Count
14BF A02A07    818          MOV AL,[DEVICE_NO]
14C2 0C50      819          OR AL,50H
14C4 8B4404    820          MOV BYTE PTR [SI+4],AL    ; Display Character Command
14C7 C6440500 821          MOV BYTE PTR [SI+5],0      ;
14CB A08407    822          MOV AL,[LSB_LED]
14CE 8B4406    823          MOV BYTE PTR [SI+6],AL    ; Data
14D1 E838FC    824          CALL LOAD_TO_DROP
825 ;
14D4 BE1008    826          MOV SI,SPU_CMD_BF
14D7 C6440501 827          MOV BYTE PTR [SI+5],1      ;
14DB A08507    828          MOV AL,[MSB_LED]
14DE 8B4406    829          MOV BYTE PTR [SI+6],AL    ; Data
14E1 E828FC    830          CALL LOAD_TO_DROP
14E4 C3        831          RET
832 ;
833 ; ***** SPU LED & EVENT_LED Operation *****
834 ;
14E5 BE1008    835 SPU_LED_DISFL: MOV SI,SPU_CMD_BF
14E8 C60406    836          MOV BYTE PTR [SI],6          ; Length
14EB C6440104 837          MOV BYTE PTR [SI+1],4      ; Drop Command
14EF A02C07    838          MOV AL,[ID_BYTE]
14F2 8B4402    839          MOV BYTE PTR [SI+2],AL    ; Device/Drop
14F5 C6440303 840          MOV BYTE PTR [SI+3],3      ; Byte Count
14F9 A02A07    841          MOV AL,[DEVICE_NO]
14FC 0C50      842          OR AL,50H
14FE 8B4404    843          MOV BYTE PTR [SI+4],AL    ; Display Character Command
1501 C6440580 844          MOV BYTE PTR [SI+5],80H    ;
1505 A08407    845          MOV AL,[LSB_LED]
1508 8B4406    846          MOV BYTE PTR [SI+6],AL    ; Data
150B E8FEFB    847          CALL LOAD_TO_DROP
848 ;
150E BE1008    849          MOV SI,SPU_CMD_BF
1511 C6440501 850          MOV BYTE PTR [SI+5],1      ;
1515 A08507    851          MOV AL,[MSB_LED]
1518 8B4406    852          MOV BYTE PTR [SI+6],AL    ;
151B E8EEFB    853          CALL LOAD_TO_DROP
151E C3        854          RET
855 ;

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

856 ; ***** SPU LED & EVENT_LED Operation *****
857 ;
151F BE1008 858 SPU_LED_FLASH: MOV SI,SPU_CMD_BF
1522 C60406 859 MOV BYTE PTR [SI],6 ; Length
1523 C6440104 860 MOV BYTE PTR [SI+1],4 ; Drop Command
1529 A02C07 861 MOV AL,[ID_BYTE]
152C 884402 862 MOV BYTE PTR [SI+2],AL ; Device/Drop
152F C6440303 863 MOV BYTE PTR [SI+3],3 ; Byte Count
1533 A02A07 864 MOV AL,[DEVICE_NO]
1536 0C30 865 OR AL,50H
1538 884404 866 MOV BYTE PTR [SI+4],AL ; Display Character Command
153B C6440580 867 MOV BYTE PTR [SI+5],80H ; LSB Flash
153F A08407 868 MOV AL,[LSB_LED]
1542 884406 869 MOV BYTE PTR [SI+6],AL ; Data
1545 E8C4FB 870 CALL LOAD_TO_DROP
871 ;
1548 BE1008 872 MOV SI,SPU_CMD_BF
154B C6440581 873 MOV BYTE PTR [SI+5],81H ; MSB Flash
154F A08507 874 MOV AL,[MSB_LED]
1552 884406 875 MOV BYTE PTR [SI+6],AL ; Data
1555 E8B4FB 876 CALL LOAD_TO_DROP
1558 C3 877 RET
878 ;
879 ; ***** SPU LED & EVENT_LED New Operation *****
880 ;
1559 BE1008 881 SPU_LED_FLAS: MOV SI,SPU_CMD_BF
155C C60406 882 MOV BYTE PTR [SI],6 ; Length
155F C6440104 883 MOV BYTE PTR [SI+1],4 ; Drop Command
1563 A02C07 884 MOV AL,[ID_BYTE]
1566 884402 885 MOV BYTE PTR [SI+2],AL ; Device/Drop
1569 C6440303 886 MOV BYTE PTR [SI+3],3 ; Byte Count
156D A02A07 887 MOV AL,[DEVICE_NO]
1570 0C30 888 OR AL,50H
1572 884404 889 MOV BYTE PTR [SI+4],AL ; Display Character Command
890 ;
891 ;
1575 C6440583 892 MOV BYTE PTR [SI+5],83H ; USB Flash
1579 C6440630 893 MOV BYTE PTR [SI+6],30H ; Data
157D E88CFB 894 CALL LOAD_TO_DROP
895 ;
1580 BE1008 896 MOV SI,SPU_CMD_BF
1583 C6440582 897 MOV BYTE PTR [SI+5],82H ; MSB Flash
1587 A08607 898 MOV AL,[MSB_LED]
158A 884406 899 MOV BYTE PTR [SI+6],AL ; Data
158D E87CFB 900 CALL LOAD_TO_DROP
901 ;
1590 BE1008 902 MOV SI,SPU_CMD_BF
1593 C6440580 903 MOV BYTE PTR [SI+5],80H ; LSB Flash
1597 A08407 904 MOV AL,[LSB_LED]
159A 884406 905 MOV BYTE PTR [SI+6],AL ; Data
159D E86CFB 906 CALL LOAD_TO_DROP
907 ;
15A0 BE1008 908 MOV SI,SPU_CMD_BF
15A3 C6440581 909 MOV BYTE PTR [SI+5],81H ; MSB Flash
15A7 A08507 910 MOV AL,[MSB_LED]
15AA 884406 911 MOV BYTE PTR [SI+6],AL ; Data
15AD E85CFB 912 CALL LOAD_TO_DROP

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1580 C3          913          RET
                  914 ; ***** Authorize Sareteirukai ---> CY *****
1581 E85F00      915 AUTHO_FAI: CALL CONV_BIT_AL ; AL = 2 ** CONV_NO
1584 881E1E07   916          MOV BX,WORD PTR [BINAPY_LED]
1588 BE9001      917          MOV SI,BASIC_AUTHO
158B 2200        918          AND AL,[SI][BX] ; Z = 0 --- No
158D C3          919          RET
                  920 ; ***** IF PC Code=0 Then Z=1 ELSE Z=0 *****
158E 53          921 PC_CODE_0_KAI: PUSH BX
158F 56          922          PUSH SI
15C0 BE2000      923          MOV SI,PC_CODE
15C3 B700        924          MOV BH,0
15C5 8A1E2407    925          MOV BL,[CONV_NO]
15C9 02DB        926          ADD BL,BL
15CB 8B10        927          MOV DX,[SI][BX]
15CD 83FA00      928          CMP DX,0
15D0 5E          929          POP SI
15D1 5B          930          POP BX
15D2 C3          931          RET
                  932 ; ***** IF SC Mode Then Z=1 ELSE Z=0 *****
15D3 E83D00      933 SC_MODE_KAI: CALL CONV_BIT_AL
15D6 22060E00    934          AND AL,[SCAN_MODE_FLAG]
15DA C3          935          RET
                  936 ;
15DB BE2000      937 PC_CODE_ADRS: MOV SI,PC_CODE
15DE B700        938          MOV BH,0
15E0 8A1E2407    939          MOV BL,[CONV_NO]
15E4 02DB        940          ADD BL,BL
15E6 C3          941          RET
                  942 ; ***** PC/FC List & Authorize CY= 1 --- None *****
15E7 50          943 PCFC_MAP_ARUKA: PUSH AX
15E8 E82800      944          CALL CONV_BIT_AL ; AL = 2 ** CONV_NO
15EB BE0001      945          MOV SI,PC_FC_LIST
15EE B100        946          MOV CL,0
15F0 8AE0        947 AKANE:   MOV AH,AL ; Z = 0 --- No
15F2 2224        948          AND AH,[SI]
15F4 22A48000    949          AND AH,[SI+128]
15F8 730B        950          JNZ AKANE_CHAN
15FA 46          951          INC SI
15FB FEC1        952          INC CL
15FD 80F964      953          CMP CL,100
1600 75EE        954          JNZ AKANE
1602 5B          955          POP AX
1603 F9          956          STC
1604 C3          957          RET
1605 5B          958 AKANE_CHAN: POP AX
1606 F8          959          CLC
1607 C3          960          RET
                  961 ; ***** Drop No. Bit Position ---> AL *****
1608 51          962 DROP_BIT_AL: PUSH CX
1609 8A0E2607    963          MOV CL,[DROP_NO]
160D B001        964          MOV AL,1
160F D2C0        965          ROL AL,CL
1611 59          966          POP CX
1612 C3          967          RET
                  968 ; ***** Converter Bit Position ---> AL *****
1613 51          969 CONV_BIT_AL: PUSH CX

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1614 8A0E2407      970      MOV CL,[CONV_NO]
1618 B001          971      MOV AL,1
161A D2C0          972      ROL AL,CL
161C 39            973      POP CX
161D C3            974      RET
                  975 ; ***** Device Bit Position ---> AL *****
161E 51            976 DEVICE_BIT_AL: PUSH CX
161F 8A0E2A07      977      MOV CL,[DEVICE_NO]
1623 B001          978      MOV AL,1
1625 D2C0          979      ROL AL,CL
1627 39            980      POP CX
1628 C3            981      RET
                  982 ; ***** EVENT Mode ---> Basic Mode *****
1629 A02E07        983 EVENT_TO_BASIC: MOV AL,[CONV_NO_BIT]
162C 343F          984      XOR AL,3FH
162E 20068007      985      AND [NOW_EVENT],AL
1632 C3            986      RET
                  987 ; ***** Timer Set Operation *****
1633 B90200        988 TIMER_02_SEC:  MOV CX,2
1636 E92B00        989      JMP TIMER_SET_CX
1639 B90400        990 TIMER_04_SEC:  MOV CX,4
163C E92500        991      JMP TIMER_SET_CX
163F B90500        992 TIMER_05_SEC:  MOV CX,5
1642 E91F00        993      JMP TIMER_SET_CX
1645 90            994 TIMER_UD_SEC:  NOP
1646 B90A00        995 TIMER_1_SEC:   MOV CX,10
1649 E91800        996      JMP TIMER_SET_CX
164C B91400        997 TIMER_2_SEC:   MOV CX,20
164F E91200        998      JMP TIMER_SET_CX
1652 B93200        999 TIMER_3_SEC:   MOV CX,30
1655 E90C00       1000      JMP TIMER_SET_CX
1658 B96400       1001 TIMER_10_SEC:  MOV CX,100
165B E90600       1002      JMP TIMER_SET_CX
165E B92C01       1003 TIMER_30_SEC:  MOV CX,300
1661 E90000       1004      JMP TIMER_SET_CX
1664 53            1005 TIMER_SET_CX:  PUSH BX
1665 56            1006      PUSH SI
1666 BE0003        1007      MOV SI,TIME_TABLE
1669 B700          1008      MOV BH,0
166B 8A1E2907     1009      MOV BL,[IC_BYTE]
166F 020B         1010      ADD BL,BL
1671 8908         1011      MOV [SI][BX],CX
1673 5E           1012      POP SI
1674 5B           1013      POP BX
1675 C3           1014      RET
                  1015 ;
1676 B81200        1016 ; ***** IBF Interrupt Unmask *****
1679 9A3AFF        1017 ;
167C EF           1018 IBF_UNMASK:  MOV     AX,12H
167D C3           1019      MOV     DX,0FF3AH      ; IBF Interrupt Unmask
                  1020      OUT     DX,AX
                  1021      RET
                  1022 ;
                  1023 ; ***** Channel Table ---> LED *****
                  1024 ;
167E BE1000       1025 VIEW_TBL_LED:  MOV SI,VIEW_CHANNEL ; [ID_BYTE]
1681 B700         1026      MOV BH,0

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1683 8A1E2407 1027      MOV BL,[CONV_NO1
1687 8A20      1028      MOV AH,[SI][BX]
1689 8A4008    1029      MOV AL,[SI][BX+8]
168C 8B268507 1030      MOV [MSB_LED],AH
1690 A28407    1031      MOV [LSB_LED],AL
1693 8B08      1032      MOV BX,AX
1695 C3        1033      RET
1034 ;
1035 ; ***** LED ---> BX *****
1036 ;
1696 8A3E8507 1037 LED_BIN_BX:  MOV BH,[MSB_LED] ; BX <--- LED
169A 8A1E8407 1038      MOV BL,[LSB_LED]
1039 ;
1040 ; ***** Decimal to Binary *****
1041 ;
169E 80E30F    1042 DECBIN_BX:  AND BL,0FH ; BX ASCII Decimal ---> BX Binary
16A1 80E70F    1043      AND BH,0FH
16A4 02FF      1044      ADD BH,BH
16A6 02DF      1045      ADD BL,BH ; BL=BL+(2*BH)
16A8 02FF      1046      ADD BH,BH ; BH=2*(2*BH)
16AA 02FF      1047      ADD BH,BH ; BH=2*(2*(2*BH))
16AC 02DF      1048      ADD BL,BH ; BL=BL+(2*BH)+2*(2*(2*BH))
16AE B700      1049      MOV BH,0 ; =BL+10*BH
16B0 891E1E07 1050      MOV WORD PTR [BINARY_LED],BX
16B4 C3        1051      RET
1052 ;
1053 ; ***** LED ---> VIEW_TABLE *****
1054 ;
16B5 BE1000    1055 LED_VIEW_TBL: MOV SI,VIEW_CHANNEL ;
16B8 B700      1056      MOV BH,0 ;
16BA 8A1E2407 1057      MOV BL,[CONV_NO1 ;
16BE 8A268507 1058      MOV AH,[MSB_LED] ;
16C2 8820      1059      MOV [SI][BX],AH ; Last Channel Memory Ni Iteru
16C4 A08407    1060      MOV AL,[LSB_LED] ;
16C7 884008    1061      MOV [SI][BX+8],AL ;
16CA C3        1062      RET
1063 ;
1064 ; ***** IF KEYIN THEN GOTO BASE_ROUTINE *****
1065 ;
16CB A08907    1066 IF_KEY_GO_BASE: MOV AL,[KEY_DATA]
16CE 3C00      1067      CMP AL,TIMER_OUT_CODE
16D0 7404      1068      JZ TIMER_ON
16D2 5A        1069      POP DX
16D3 E93D01    1070      JMP BASE_ROUTINE
16D6 C3        1071 TIMER_ON:  RET
1072 ;
1073 ; ***** SCAN Mode Up Channel Search *****
1074 ;
16D7 E8A4FF    1075 DM_SCAN_SEARCH: CALL VIEW_TBL_LED
16DA E8B9FF    1076      CALL LED_BIN_BX
16DD E833FF    1077      CALL CONV_BIT_AL
16E0 BE8001    1078      MOV SI,BASIC_AUTH0
16E3 FECB      1079 URI:      DEC BL
16E5 80FB00    1080      CMP BL,0
16E8 7503      1081      JNZ URI1
16EA BB6300    1082      MOV BX,99
16ED 8AE0      1083 URI1:     MOV AH,AL

```



## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

16EF 2220      1084      AND AH,[SI][BX]
16F1 74F0      1085      JZ URI
16F3 E96200    1086      JMP UD_CONV_DISP
                1087 ;
                1088 ; ***** PCFC Mode Up Channel Search *****
                1089 ;
16F6 E885FF    1090 DW_PCFC_SEARCH: CALL VIEW_TBL_LED
16F9 E89AFF    1091      CALL LED_BIN_BX
16FC E814FF    1092      CALL CONV_BIT_AL
16FF BE0001    1093      MOV SI,PC_FC_LIST
1702 FECB      1094 UK1:    DEC BL
1704 80FB00    1095      CMP BL,0
1707 7503      1096      JNZ UK11
1709 BB6300    1097      MOV BX,99
170C 8AE0      1098 UK11:   MOV AH,AL
170E 2220      1099      AND AH,[SI][BX]
1710 22A08000  1100      AND AH,[SI+128][BX]
1714 74EC      1101      JZ UK1
1716 E93F00    1102      JMP UD_CONV_DISP
                1103 ;
                1104 ; ***** PCFC Mode Up Channel Search *****
                1105 ;
1719 E862FF    1106 UP_PCFC_SEARCH: CALL VIEW_TBL_LED
171C E877FF    1107      CALL LED_BIN_BX
171F E8F1FE    1108      CALL CONV_BIT_AL
1722 BE0001    1109      MOV SI,PC_FC_LIST
1725 FEC3      1110 UMI:    INC BL
1727 80FB64    1111      CMP BL,100
172A 7203      1112      JC UMI1
172C BB0100    1113      MOV BX,1
172F 8AE0      1114 UMI1:   MOV AH,AL
1731 2220      1115      AND AH,[SI][BX]
1733 22A08000  1116      AND AH,[SI+128][BX]
1737 74EC      1117      JZ UMI
1739 E91C00    1118      JMP UD_CONV_DISP
                1119 ;
                1120 ; ***** SCAN Mode Up Channel Search *****
                1121 ;
173C E83FFF    1122 UP_SCAN_SEARCH: CALL VIEW_TBL_LED
173F E854FF    1123      CALL LED_BIN_BX
1742 E8CEFE    1124      CALL CONV_BIT_AL
1745 BE0001    1125      MOV SI,BASIC_AUTHO
1748 FEC3      1126 UKA:    INC BL
174A 80FB64    1127      CMP BL,100
174D 7203      1128      JC UKA1
174F BB0100    1129      MOV BX,1
1752 8AE0      1130 UKA1:   MOV AH,AL
1754 2220      1131      AND AH,[SI][BX]
1756 74F0      1132      JZ UKA
                1133 ;
1758 E8CEFE    1134 UD_CONV_DISP: CALL EVENT_TO_BASIC
175B E80A00    1135      CALL BINDEC_LED
175E E854FF    1136      CALL LED_VIEW_TBL
1761 E847FD    1137      CALL SPU_LED_DISP
1764 E841FB    1138      CALL GO_CONVERTER
1767 C3        1139      RET
                1140 ;

```

SOURCE LINE

```

1749 8706      1141 B1MVEC_LED:      MOV BH,0
174A 80F80A    1142 HITON1:      CNP BL,10
174D 7207      1143              JC  RAKD
174F 80E0DA    1144              SUB BL,10
1772 FEC7      1145              INC BH
1774 EBF4      1146              JMP HITON1
1776 81C03030  1147 RAKD:          OR BH,3030H
177A 801E0407  1148              MOV CL,SP_LED3,BL
177E 803E9507  1149              MOV (H8B_LED3),BH
1782 C3        1150              RET
1783 E94DFE    1151 ; ***** SC/FC/PC Mode Mo AX ni Set Suru *****
1786 7404      1152 SCFCPC_MODE_AX: CALL SC_MODE_Fai
1788 804333    1153              JC  SAKD1_FCF
1789 C3        1154              MOV AX,ASCII_SC      : [ SCAN Mode ]
1790 C3        1155              RET
179C E82FFE    1156 ;
179F 7504      1157 SAKD1_FCPC:     CALL SC_CODE_0_KA)
1799 C3        1158              JNZ SAKD1_PC
1799 804344    1159 ;
179A C3        1160              MOV AX,ASCII_FC      : [ FC Mode ]
179B C3        1161              RET
179C C3        1162 ;
179D 804350    1163 SAKD1_PC:       MOV AX,ASCII_PC      : [ PC Mode ]
179E C3        1164              RET
179F C3        1165
179F C3        1166
179F C3        1167
179F C3        1168
179F C3        1169
179F C3        1170
179F C3        1171
179F C3        1172
179F C3        1173
179F C3        1174
179F C3        1175 ;
179F C3        1176 ;
179F C3        1177 ;      -Key Operation
179F C3        1178 ;
179F C3        1179 ;
179F C3        1180 ;
179F C3        1181 ;
179F C3        1182 ;
179F C3        1183 ;
179F C3        1184 ;
179F C3        1185 ;
179F C3        1186 ;
179F C3        1187 ;
179F C3        1188 ;
179F C3        1189 ;
179F C3        1190 ;
179F C3        1191 ;
179F C3        1192 ;
179F C3        1193 ;
179F C3        1194 ;
179F C3        1195 ;
179F C3        1196 ;
179F C3        1197 ;
179F C3        1198 ;
179F C3        1199 ;
179F C3        1200 ;
179F C3        1201 ;
179F C3        1202 ;
179F C3        1203 ;
179F C3        1204 ;
179F C3        1205 ;
179F C3        1206 ;
179F C3        1207 ;
179F C3        1208 ;
179F C3        1209 ;
179F C3        1210 ;
179F C3        1211 ;
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179F C3        1229 ;
179F C3        1230 ;
179F C3        1231 ;
179F C3        1232 ;
179F C3        1233 ;
179F C3        1234 ;
179F C3        1235 ;
179F C3        1236 ;
179F C3        1237 ;
179F C3        1238 ;
179F C3        1239 ;
179F C3        1240 ;
179F C3        1241 ;
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179F C3        1286 ;
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179F C3        1297 ;
179F C3        1298 ;
179F C3        1299 ;
179F C3        1300 ;
179F C3        1301 ;
179F C3        1302 ;
179F C3        1303 ;
179F C3        1304 ;
179F C3        1305 ;
179F C3        1306 ;
179F C3        1307 ;
179F C3        1308 ;
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179F C3        1365 ;
179F C3        1366 ;
179F C3        1367 ;
179F C3        1368 ;
179F C3        1369 ;
179F C3        1370 ;
179F C3        1371 ;
179F C3        1372 ;
179F C3        1373 ;
179F C3        1374 ;
179F C3        1375 ;
179F C3        1376 ;
179F C3        1377 ;
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179F C3        1389 ;
179F C3        1390 ;
179F C3        1391 ;
179F C3        1392 ;
179F C3        1393 ;
179F C3        1394 ;
179F C3        1395 ;
179F C3        1396 ;
179F C3        1397 ;
179F C3        1398 ;
179F C3        1399 ;
179F C3        1400 ;
179F C3        1401 ;
179F C3        1402 ;
179F C3        1403 ;
179F C3        1404 ;
179F C3        1405 ;
179F C3        1406 ;
179F C3        1407 ;
179F C3        1408 ;
179F C3        1409 ;
179F C3        1410 ;
179F C3        1411 ;
179F C3        1412 ;
179F C3        1413 ;
179F C3        1414 ;
179F C3        1415 ;
179F C3        1416 ;
179F C3        1
```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

17BB 8700      1198 NEXT_OS:      MOV BH,0
17BD 8A1E2807  1199              MOV BL,[IC_BYTE]
17C1 02DB      1200              ADD BL,BL
17C3 BE8003    1201              MOV SI,JUMP_ADDRESS
17C6 8900      1202              MOV [BX][SI],AX
17C8 C3        1203 RETURN_OS:  RET
1204 ;-----
1205 ;
1206 ;          SPU Initial Off Mode
1207 ;
1208 ;-----
17C9 8A0E8907  1209 OP_INITIAL:  MOV CL,[KEY_DATA]
17CD 80F913    1210              CMP CL,ONOFF_KEY_CODE
17D0 7311      1211              JNZ MP_100_CK_001
17D2 E854FE    1212              CALL EVENT_TO_BASIC
17D5 E8BEFC    1213              CALL SPU_VIEW_DISP
1214 ;
17D8 E8CDFA    1215              CALL GO_CONVERTER
1216 ;
17DB E8D6FB    1217 WAKEARI_DE_ON: CALL SPU_RELAY_ON
1218 ;
17DE A11A07    1219              MOV AX,[BASE_POINT]
17E1 EBD8      1220              JMP NEXT_OS
1221 ;
1222 ; *****
1223 ;
17E3 80F911    1224 MP_100_CK_001:  CMP CL,EVENT_KEY_CODE
17E6 7524      1225              JNZ MP_100_CK_002
17E8 B430      1226              MOV AH,30H
17EA E8ADF8    1227              CALL CONV_SW_FLAG
17ED 7402      1228              JZ CONV_SW_OK_Y0
17EF B431      1229 CONV_SW_NC_Y0:  MOV AH,31H
17F1 A02A07    1230 CONV_SW_OK_Y0:  MOV AL,[DEVICE_NO]
17F4 0C30      1231              OR AL,30H
17F6 88268507  1232              MOV [MSB_LED],AH
17FA A28407    1233              MOV [LSB_LED],AL
17FD A02407    1234              MOV AL,[CONV_NO]
1800 0C30      1235              OR AL,30H
1802 FEC0      1236              INC AL
1804 A28607    1237              MOV [MSB_LED],AL
1807 E84FFD    1238              CALL SPU_LED_FLAST
180A E8BC      1239              JMP RETURN_OS
180C 80F917    1240 MP_100_CK_002:  CMP CL,SEND_KEY_CODE
180F 75B7      1241              JNZ RETURN_OS
1242 ;
1811 E8B5      1243              CALL SPECIAL_SPU_1
1244 ;
1245 ;
1246 ;          Base Routine
1247 ;
1248 ;-----
1813 A08907    1249 BASE_ROUTINE:  MOV AL,[KEY_DATA]
1816 E8EBF8    1250              CALL KAZUKO
1819 7334      1251              JNC RANDOM_ACCESS
181B 3C10      1252              CMP AL,PLUS_KEY_CODE
181D 7503      1253              JNZ BASE1
181F E92401    1254              JMP UP_CHANNEL_OP

```

**SOURCE LINE**

```

1822 3C11:      1255 BASE1:      CMP AL,EVENT_KEY_CODE
1824 7503      1256          JNZ BASE2
1826 E94703    1257          JMP EVENT_KEY_OP
1829 3C12      1258 BASE2:      CMP AL,AUTHO_KEY_CODE
182B 7503      1259          JNZ BASE3
182D E99A01    1260          JMP AUTHO_KEY_OP
1830 3C14      1261 BASE3:      CMP AL,MINUS_KEY_CODE
1832 7503      1262          JNZ BASE4
1834 E9A701    1263          JMP DOWN_CH_OP
1837 3C15      1264 BASE4:      CMP AL,SCAN_KEY_CODE
1839 7503      1265          JNZ BASE5
183B E91502    1266          JMP SCAN_KEY_OP
183E 3C16      1267 BASE5:      CMP AL,CLEAR_KEY_CODE
1840 7503      1268          JNZ BASE6
1842 E99C02    1269          JMP CLEAR_KEY_OP
1845 3C17      1270 BASE6:      CMP AL,SEND_KEY_CODE
1847 7503      1271          JNZ BASE7
1849 E9AB02    1272          JMP SEND_KEY_OP
184C E98400    1273 BASE7:      JMP NEXT_END ; Zooooooooooooooooooooooooooooooooooooo
1274 ; -----
1275 ;
1276 ; Random Access Routine
1277 ;
1278 ; -----
184F B700      1279 RANDOM_ACCESS: MOV BH,0
1851 8A1E2807   1280          MOV BL,[IC_BYTE]
1853 8BF3        1281          MOV SI,BX
1857 EB6406     1282          CALL KEY_BUFF_ADRS
185A 8800       1283          MOV [BX][SI],AL
1284 ;
185C A28507     1285          MOV [MSB_LED],AL
185F B088       1286          MOV AL,88H ; LSB = " "
1861 A28407     1287          MOV [LSB_LED],AL
1864 E87EFC     1288          CALL SPU_LED_DISFL
1867 EBEBFD     1289          CALL TIMER_5_SEC
1290 ;
186A E84DFF     1291          CALL NEXT_CONTINUE ; [[[ Key Input Wait ]]]
1292 ;
186D A08907     1293          MOV AL,[KEY_DATA]
1870 EB91F8     1294          CALL KAZUKO
1873 7264       1295          JC RANDOM_OUT
1875 B700       1296          MOV BH,0 ;
1877 8A1E2807   1297          MOV BL,[IC_BYTE] ;
187B 8BF3       1298          MOV SI,BX
187D EB3E06     1299          CALL KEY_BUFF_ADRS ; AH = [ 1st KEY ]
1880 8A20       1300          MOV AH,[SI][BX] ; AL = [ KEY_DATA ]
1301 ;
1882 A28407     1302          MOV [LSB_LED],AL ; LED Display
1885 8B268507   1303          MOV [MSB_LED],AH ;
1889 EB3206     1304          CALL KEY_BUFF_ADRS ;
188C 894004     1305          MOV [SI][BX+4],AX ;
188F EB19FC     1306          CALL SPU_LED_DISP ;
1307 ;
1892 EB01FE     1308          CALL LED_BIN_BX
1895 EB19FD     1309          CALL AUTHO_KAI
1898 747D       1310          JZ WT_NO_WT_END
1311 ;

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HEWLETT-PACKARD: 8086 Assembler

SOURCE LINE

```

189A E836FD 1312 CALL SC_MODE_KAI
189D 752B 1313 JNZ TUNE_SURU
189F E81CFD 1314 CALL PC_CODE_0_KAI
18A2 7426 1315 JZ TUNE_SURU
1316 ;
18A4 E8EFFD 1317 CALL LED_BIN_BX. ; PC Mode Daga PC-Map Ni Aruka
18A7 E869FD 1318 CALL CONV_BIT_AL
18AA 8E0001 1319 MOV SI,PC_FC_LIST
18AD 2200 1320 AND AL,[SI](BX)
18AF 7519 1321 JNZ TUNE_SURU
1322 ;
18B1 E87305 1323 CALL ANGO_INPUT ;
18B4 E82E06 1324 CALL ANGO_BIN_DX ;
18B7 E821FD 1325 CALL PC_CODE_ADRS ;
18BA 3B10 1326 CMP DX,[SI](BX) ;
18BC 7524 1327 JNZ MSGERR_UT_END ; IF PC_CODE (<) Input Code Then PC_Control
18BE E8FD05 1328 CALL KEY_BUFF_ADRS ;
18C1 8B4004 1329 MOV AX,[SI](BX+4) ;
18C4 A3B407 1330 MOV [LSB_LED].AX ;
18C7 E8E1FB 1331 CALL SPU_LED_DISP ;
1332 ;
18CA E85CFD 1333 TUNE_SURU: CALL EVENT_TO_BASIC
1334 ;
18CD E8E3FD 1335 CALL LED_VIEU_TBL
1336 ;
18D0 E81CF9 1337 CALL RUN_CONVERTER
1338 ;
18D3 A11A07 1339 NEXT_END: MOV AX,[BASE_POINT]
18D6 E9E2FE 1340 JMP NEXT_OS
1341 ;
18D9 3C16 1342 RANDOM_OUT: CMP AL,CLEAR_KEY_CODE
18DB 75B5 1343 JNZ MSGERR_UT_END
18DD E8B6FB 1344 CALL SPU_VIEU_DISP
18E0 EBF1 1345 JMP NEXT_END
1346 ;
18E2 B87245 1347 MSGERR_UT_END: MOV AX,ASCII_ER
18E5 E8BCFB 1348 MSG_UT_END: CALL SPU_LED_WX
18E8 E85BFD 1349 WAIT_END: CALL TIMER_1_SEC
1350 ;
18EB E8CCFE 1351 IF_TIMEOUT_END: CALL NEXT_CONTINUE
1352 ;
18EE A08907 1353 MOV AL,[KEY_DATA]
18F1 3C00 1354 CMP AL,TIMEP_OUT_CODE
18F3 7403 1355 JZ RANDOM_MODORI
18F5 E918FF 1356 JMP BASE_ROUTINE
1357 ;
18F8 A08007 1358 RANDOM_MODORI: MOV AL,[MOV_EVENT]
18FB 84062E07 1359 TEST AL,[(CONV_NO_BIT)]
18FF 75D5 1360 JNZ EVENT_MODORI
1901 E892FB 1361 CALL SPU_VIEU_DISP
1904 EBCD 1362 JMP NEXT_END
1906 BE3000 1363 EVENT_MODORI: MOV SI,EVENT_CHANNEL
1909 03362407 1364 ADD SI,[CONV_NO]
190D 8B1C 1365 MOV BX,[SI]
190F E856FE 1366 CALL BINDEC_LED
1912 E896FB 1367 CALL SPU_LED_DISP
1915 E8BC 1368 JMP NEXT_END

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1369 ;
1370 ;
1371 WT_NO_WT_END: CALL TIMER_1_SEC
1372 ;
1373 ; CALL NEXT_CONTINUE
1374 ;
1375 MOV AL,[KEY_DATA]
1376 CMP AL,TIMER_OUT_CODE
1377 JZ MSG_NO_WT_END
1378 JMP BASE_ROUTINE
1379 MSG_NO_WT_END: MOV AX,ASCII_NO ; 1 Sec. "No"
1380 JMP MSG_WT_END
1381
1382
1383
1384 ;
1385 ;
1386 ;
1387 ;
1388 ; SPU OFF Key Operation
1389 ;
1390 OP_SPU_OFF: CALL SPU_RELAY_OFF
1391 CALL SPU_CLEAR_DISP
1392 CALL EVENT_LED_OFF
1393 ;
1394
1395 MOV AX,LIMIT_POINTJ
1396 CALL NEXT_OS ; Korewa Tanneru Junbideari Mada OS niwamodorans
1397 CALL STP_CONVERTER
1398 JC MAKI
1399
1400 CALL CONV_P_OFF_CMD
1401
1402 MAKI: JMP RETUPN_OS ; Modoru Junbiwa Shitsarunode Return
1403
1404
1405
1406 ;
1407 ;
1408 ;
1409 ; UP Channel Change
1410 ;
1411 UP_CHANNEL_OP: CALL CONV_BIT_AL
1412 AND AL,[SCAN_MODE_FLAG]
1413 JZ UP_PCFC
1414 ;
1415 UP_SCAN: CALL UP_SCAN_SEARCH
1416 CALL TIMER_OS_SEC
1417 ;
1418 CALL NEXT_CONTINUE
1419 ;
1420 MOV AL,[KEY_DATA]
1421 CMP AL,TIMER_OUT_CODE
1422 JNZ UP_DOWN_EXIT
1423 ;
1424 YUKO: CALL SPU_STATUS_REQ
1425 CALL TIMEP_UD_SEC

```

: U/D Sugu Hanashita

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HEWLETT-PACKARD: 8086 Assembler

SOURCE LINE

```

1426 ;
1965 E852FE 1427 CALL NEXT_CONTINUE
1428 ;
1968 A02907 1429 MOV AL,[KEY_DATA]
196B 3C1C 1430 CMP AL,KEY_PUSH_CODE
196D 7548 1431 JNZ UP_DOWN_EXIT ; Key Release or Another Key
196F E8CAFD 1432 CALL UP_SCAN_SEARCH
1972 E8BEFC 1433 CALL TIMER_02_SEC
1434 ;
1975 E842FE 1435 CALL NEXT_CONTINUE
1436 ;
1978 A08907 1437 MOV AL,[KEY_DATA]
197B 3C00 1438 CMP AL,TIMER_OUT_CODE
197D 74E0 1439 JZ YUKO
197F E93500 1440 JMP UP_DOWN_EXIT ; Another Key
1441
1442 ; ***** PC-FC Mode *****
1982 E862FC 1443 UP_PCFC: CALL PCFC_Map_ARUKA
1985 7240 1444 JC UP_NO_MAP
1445 ;
1987 E8FFFD 1446 CALL UP_PCFC_SEARCH
198A E8B2FC 1447 CALL TIMER_05_SEC
1448 ;
198D E82AFE 1449 CALL NEXT_CONTINUE
1450 ;
1990 A08907 1451 MOV AL,[KEY_DATA]
1993 3C00 1452 CMP AL,TIMER_OUT_CODE
1995 7520 1453 JNZ UP_DOWN_EXIT
1454 ;
1997 E8DCF9 1455 YASUKO: CALL SPU_STATUS_REG
199A E8A8FC 1456 CALL TIMER_UD_SEC
1457 ;
199D E81AFE 1458 CALL NEXT_CONTINUE
1459 ;
19A0 A08907 1460 MOV AL,[KEY_DATA]
19A3 3C1C 1461 CMP AL,KEY_PUSH_CODE
19A5 7510 1462 JNZ UP_DOWN_EXIT
19A7 E86FFD 1463 CALL UP_PCFC_SEARCH
19AA E886FC 1464 CALL TIMER_02_SEC
1465 ;
19AD E80AFE 1466 CALL NEXT_CONTINUE
1467 ;
19B0 A08907 1468 MOV AL,[KEY_DATA]
19B3 3C00 1469 CMP AL,TIMER_OUT_CODE
19B5 74E0 1470 JZ YASUKO
1471 ;
1472 ;
19B7 A08907 1473 UP_DOWN_EXIT: MOV AL,[KEY_DATA]
19BA 3C00 1474 CMP AL,TIMER_OUT_CODE
19BC 7506 1475 JNZ MIKA
19BE E8D5FA 1476 CALL SPU_VIEW_DISP
19C1 E82BF8 1477 CALL RUN_CONVERTER
19C4 E94CFE 1478 MIKA: JMP BASE_ROUTINE
1479 ;
19C7 E95DFF 1480 UP_NO_MAP: JMP MSG_NO_UT_END
1481
1482 ;-----

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1483 ;
1484 ;           Adding Channels to the FC/PC List
1485 ;
1486 ;-----
19CA E8B1FC 1487 AUTHO_KEY_OP: CALL VIEW_TBL_LED
19CD E8C6FC 1488 CALL LED_BIN_BX
19D0 BE0001 1489 MOV SI,PC_FC_LIST
19D3 E83DFC 1490 CALL CONV_BIT_AL
19D6 0800 1491 OR [SI],BX,AL
19D8 B86441 1492 MOV AX,ASCII_AD
19DB E907FF 1493 JMP MSG_WT_END
1494 ;-----
1495 ;
1496 ;           Down Channel Change
1497 ;-----
19DE E832FC 1498 DOWN_CH_OP: CALL CONV_BIT_AL
19E1 22060E00 1499 AND AL,[SCAN_MODE_FLAG]
19E5 7432 1500 JZ DW_PCFC
1501 ;
19E7 E8EDFC 1502 DW_SCAN: CALL DW_SCAN_SEARCH
19FA E852FC 1503 CALL TIMER_05_SEC
1504 ;
1505 ;
19ED E8CAFD 1506 CALL NEXT_CONTINUE
1507 ;
19F0 A08907 1508 MOV AL,[KEY_DATA]
19F3 3C00 1509 CMP AL,TIMER_OUT_CODE
19F5 7520 1510 JNZ DOWN_EXIT
1511 ;
19F7 E87CF9 1512 EIKO: CALL SPU_STATUS_REQ
19FA E848FC 1513 CALL TIMER_UD_SEC
1514 ;
1515 ;
19FD E8BAFD 1516 CALL NEXT_CONTINUE
1517 ;
1A00 A08907 1517 MOV AL,[KEY_DATA]
1A03 3C1C 1518 CMP AL,KEY_PUSH_CODE
1A05 7510 1519 JNZ DOWN_EXIT
1A07 E8CDFC 1520 CALL DW_SCAN_SEARCH
1A0A E826FC 1521 CALL TIMER_02_SEC
1522 ;
1A0D E8AAFD 1523 CALL NEXT_CONTINUE
1524 ;
1A10 A08907 1525 MOV AL,[KEY_DATA]
1A13 3C00 1526 CMP AL,TIMER_OUT_CODE
1A15 74E0 1527 JZ EIKO
1A17 EB9E 1528 DOWN_EXIT: JMP UP_DOWN_EXIT
1529 ; ***** PC-FC Mode *****
1A19 E8CBFB 1530 DW_PCFC: CALL PCFC_MAP_ARUKA
1A1C 7232 1531 JC DW_NO_MAP
1532 ;
1A1E E8D5FC 1533 CALL DW_PCFC_SEARCH
1A21 E81BFC 1534 CALL TIMER_05_SEC
1535 ;
1A24 E893FD 1536 CALL NEXT_CONTINUE
1537 ;
1A27 A08907 1538 MOV AL,[KEY_DATA]
1A2A 3C00 1539 CMP AL,TIMER_OUT_CODE

```



## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1A2C 75E9      1540      JNZ DOWN_EXIT
1A2E E045F9    1541 ;
1A31 E011FC    1542 KEIKO:    CALL SPU_STATUS_REQ
1A34 E003FD    1543      CALL TIMER_UD_SEC
1A37 A00707    1544 ;
1A3A 3C1C      1545      CALL NEXT_CONTINUE
1A3C 73D9      1546 ;
1A3E E005FC    1547      MOV AL,[KEY_DATA]
1A41 E0E9FB    1548      CMP AL,KEY_PUSH_CODE
1A44 E073FD    1549      JNZ DOWN_EXIT
1A47 A00907    1550      CALL DU_PCPC_SEARCH
1A4A 3C00      1551      CALL TIMER_02_SEC
1A4C 74E0      1552 ;
1A4E EBC7      1553      CALL NEXT_CONTINUE
1A50 E9D4FE    1554 ;
1555      MOV AL,[KEY_DATA]
1556      CMP AL,TIMER_OUT_CODE
1557      JZ KEIKO
1558      JMP DOWN_EXIT
1559 ;
1560 DU_NO_MAP: 1560      JMP MSG_NO_UT_END
1561
1562
1563
1564
1565
1566
1567 -----
1568 ;
1569 ;          SCAN Key Operation
1570 ;
1571 -----
1A53 E020FD    1572 SCAN_KEY_OP: CALL SCFCPC_NODE_AX
1A56 E048FA    1573      CALL SPU_LED_AX
1A59 E0F6FD    1574      CALL TIMER_5_SEC
1575 ;
1A5C E050FD    1576      CALL NEXT_CONTINUE
1577 ;
1A5F A00907    1578      MOV AL,[KEY_DATA]
1A62 3C00      1579      CMP AL,TIMER_OUT_CODE
1A64 7503      1580      JNZ SCAN_AFTER
1A66 E98FFE    1581      JMP RANDOM_MDDORI
1582 ;
1A69 3C15      1583 SCAN_AFTER:  CMP AL,SCAN_KEY_CODE
1A6B 7539      1584      JNZ SCAN_ANOTHER
1585 ; -----
1A6D E04EFB    1586 SCAN_SCAN:  CALL PC_CODE_0_KAI
1A70 7410      1587      JZ SC_FC_PC_XCHG
1588 ;
1A72 E0B203    1589      CALL ANGO_INPUT
1A75 E06D04    1590      CALL ANGO_BIN_DX
1A78 E060FB    1591      CALL PC_CODE_ADRS
1A7B 3B10      1592      CMP DX,[SI][BX]
1A7D 7403      1593      JZ SC_FC_PC_XCHG      ; IF PC_CODE <> Input Code Then PC_Error
1594 ;
1A7F E960FE    1595      JMP MSGERR_UT_END
1596 ;

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1A82 E8BEFB 1597 SC_FC_PC_XCHG: CALL CONV_BIT_AL
1A85 30060E00 1598 XOR [SCAN_MODE_FLAG],AL
1A89 22060E00 1599 AND AL,[SCAN_MODE_FLAG]
1A8D 7406 1600 JZ EM1_TO_FCPC
1A8F B84353 1601 EM1_TO_SCAN: MOV AX,ASCII_SC
1A92 E950FE 1602 JMP MSG_WT_END
1A95 E826FB 1603 EM1_TO_FCPC: CALL PC_CODE_0_KAI
1A98 7306 1604 JNZ EM1_TO_PC
1A9A B84346 1605 EM1_TO_FC: MOV AX,ASCII_FC
1A9D E945FE 1606 JMP MSG_WT_END
1AA0 B84350 1607 EM1_TO_PC: MOV AX,ASCII_PC
1AA3 E93FFE 1608 JMP MSG_WT_END
1609 ;
1610 ;
1611 ;
1AA6 3C12 1612 SCAN_ANOTHER: CMP AL,AUTH0_KEY_CODE
1AA8 7403 1613 JZ PC_CODE_XCHG
1AAA E966FD 1614 JMP BASE_ROUTINE
1615 ;
1616 ; IF PC_CODE = 0 THEN "NEW" ELSE ANSHO-KEY-IN
1617 ;
1AAD E80EFB 1618 PC_CODE_XCHG: CALL PC_CODE_0_KAI
1AB0 740D 1619 JZ NEW_PC_CODE
1620 ;
1AB2 E87203 1621 CALL ANGO_INPUT
1AB5 E82D04 1622 CALL ANGO_BIN_DX
1AB8 E820FB 1623 CALL PC_CODE_ADRS
1ABB 3B10 1624 CMP DX,[SI][BX]
1ABD 731F 1625 JNZ PC_CODE_ERR ; IF PC_CODE (<) Input Code Then PC_Err0
1626 ;
1ABF E8CE02 1627 NEW_PC_CODE: CALL ANGO_TOUROKU
1AC2 E87AFB 1628 CALL TIMEP_05_SEC
1629 ;
1AC5 E8F2FC 1630 CALL NEXT_CONTINUE
1631 ;
1ACB E85304 1632 CALL ANGO_DISPLAY
1ACB 7303 1633 JNC NEW_PC_SET
1ACD E912FE 1634 JMP MSGERR_WT_END
1635 ;
1AD0 E81204 1636 NEW_PC_SET: CALL ANGO_BIN_DX
1AD3 E805FB 1637 CALL PC_CODE_ADRS
1AD6 8910 1638 MOV [SI][BX],DX
1639 ;
1ADB B85541 1640 MOV AX,ASCII_AU
1ADB E907FE 1641 JMP MSG_WT_END
1642 ;
1643 ;
1ADE E901FE 1644 PC_CODE_ERR: JMP MSGERR_WT_END
1645 ;-----
1646 ;
1647 ; Deleting Channels from the FC/PC List
1648 ;
1649 ;-----
1AE1 E89AFB 1650 CLEAR_KEY_OP: CALL VIEW_TBL_LED
1AE4 EBAFFB 1651 CALL LED_BIN_BX
1AE7 BE0001 1652 MOV SI,PC_FC_LIST
1AEA E826FB 1653 CALL CONV_BIT_AL

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HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

1AED 34FF	1634	XOR AL,0FFH
1AEF 2000	1635	AND [SI][BX],AL
	1636 ;	
1AF1 B84564	1637	MOV AX,ASCII_DE
1AF4 E9EEFD	1638	JMP MSG_WT_END
	1639 ;	
	1640 ;	
	1661 ;	Send Key Function
	1662 ;	
	1663 ;	
1AF7 B84553	1664 SEND_KEY_OP:	MOV AX,ASCII_SE
1AFA E8A7F9	1665	CALL SPU_LED_AX
	1666 ;	
1AFD E813FB	1667	CALL CONV_BIT_AL
1B00 22063008	1668	AND AL,[SEND_ENABLE]
1B04 7503	1669	JNZ SEND_KYOKA
1B06 E90EFE	1670	JMP WT_NO_WT_END
	1671 ;	
1B09 E846FB	1672 SEND_KYOKA:	CALL TIMER_5_SEC
	1673 ;	
1B0C E8ABFC	1674	CALL NEXT_CONTINUE
	1675 ;	
1B0F A08907	1676	MOV AL,[KEY_DATA]
1B12 E8EFF5	1677	CALL KAZUKO
1B15 7303	1678	JNC SETUKO
1B17 E9BFFD	1679	JMP RANDOM_OUT
1B1A A28407	1680 SETUKO:	MOV [LSB_LED],AL
1B1D 8A1E3308	1681	MOV BL,[SEND_INDEX]
1B21 80FB80	1682	CMP BL,SEND_MAX
1B24 7203	1683	JC TAMIKO
1B26 E9EEFD	1684 TAM1:	JMP WT_NO_WT_END
1B29 B420	1685 TAMIKO:	MOV AH,20H
1B2B 88268507	1686	MOV [MSB_LED],AH
1B2F E88C03	1687	CALL KEY_BUFF_ADRS
1B32 A08907	1688	MOV AL,[KEY_DATA]
1B35 8808	1689	MOV [SI][BX],AL
1B37 E8ABF9	1690	CALL SPU_LED_DISFL
1B3A E815FB	1691	CALL TIMER_5_SEC
	1692 ;	
1B3D E87AFC	1693	CALL NEXT_CONTINUE
	1694 ;	
1B40 A08907	1695	MOV AL,[KEY_DATA]
1B43 3C16	1696	CMP AL,CLEAR_KEY_CODE
1B45 74B0	1697	JZ SEND_KEY_OP
1B47 3C12	1698	CMP AL,AUTHN_KEY_CODE
1B49 75DB	1699	JNZ TAM1
	1700 ;	
1B4B E87003	1701	CALL KEY_BUFF_ADRS
1B4E 8A00	1702	MOV AL,[SI][BX]
1B50 BE3508	1703	MOV SI,SEND_DATA_BUFF
1B53 8700	1704	MOV BH,0
1B55 8A1E3308	1705	MOV BL,[SEND_INDEX]
1B59 8A262807	1706	MOV AH,[IC_BYTE]
1B5D 886001	1707	MOV [SI][BX+1],AH
1B60 884002	1708	MOV [SI][BX+2],AL
1B63 80C302	1709	ADD BL,2
1B66 881E3308	1710	MOV [SEND_INDEX],BL

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

186A B85541 1711 ;
186D E975FD 1712      MOV AX,ASCII_AU
1713      JMP MSG_WT_END
1714
1715 ;-----
1716 ;
1717 ;      Event Key Operation
1718 ;
1719 ;-----
1870 E848FA 1720 EVENT_KEY_OP: CALL PC_CODE_0_KAI
1873 7410    1721      JZ EV_PC_OK_YO
1722 ;
1875 E8AF02 1723      CALL ANGO_INPUT      ; PC Code Input
1878 E86A03 1724      CALL ANGO_BIN_DX
187B E85DFA 1725      CALL PC_CODE_ADRS
187E 3B10   1726      CMP DX,[SI][BX]
1880 7403    1727      JZ EV_PC_OK_YO
1882 E95DFD 1728 EVENT_ERR: JMP MSGERR_WT_END
1729 ;
1885        1730 EV_PC_OK_YO:      ; Event Enable ?
1885 B87250 1731      MOV AX,ASCII_PR
1888 E819F9 1732      CALL SPU_LED_AX
188B E8B8FA 1733      CALL TIMER_1_SEC
1734 ;
188E E829FC 1735      CALL NEXT_CONTINUE
1736 ;
1891 E86601 1737      CALL YDYAKU_SEARCH
1894 7203   1738      JC Y_HAJIME
1896 E9C600 1739      JMP FORCED_EVENT
1740 ;
1899 B87250 1741 Y_HAJIME:  MOV AX,ASCII_PR
189C E8B5F9 1742      CALL SPU_LED_AX
189F E8B6FA 1743      CALL TIMER_10_SEC
1744 ;
18A2 E815FC 1745      CALL NEXT_CONTINUE
1746 ;
18A5 A08907 1747      MOV AL,[KEY_DATA]
18A8 E91100 1748      JMP EVENT_1ST_KEY
1749 ;
18AB E8AAFA 1750 EVENT_KEY_WAIT: CALL TIMER_10_SEC
1751 ;
18AE E809FC 1752      CALL NEXT_CONTINUE
1753 ;
18B1 A08907 1754      MOV AL,[KEY_DATA]
18B4 3C12   1755      CMP AL,AUTHO_KEY_CODE
18B6 742D   1756      JZ EVENT_AUTHO
18B8 3C16   1757      CMP AL,CLEAR_KEY_CODE
18BA 7432   1758      JZ EVENT_CLEAR
18BC 3C10   1759 EVENT_1ST_KEY: CMP AL,PLUS_KEY_CODE
18BE 7441   1760      JZ EVENT_PLUS
18C0 3C14   1761      CMP AL,MINUS_KEY_CODE
18C2 7443   1762      JZ EVENT_MINUS
18C4 3C00   1763      CMP AL,TIMER_OUT_CODE
18C6 740B   1764      JZ EVENT_T_OUT
18C8 3C11   1765      CMP AL,EVENT_KEY_CODE
18CA 740A   1766      JZ EVENT_EVENT
18CC E835F5 1767      CALL KAZUKO

```

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

18CF 733E      1768      JNC RANDOM_YOYAKU
1BD1 EBAF      1769      JMP EVENT_EPR
                1770 ;
1BD3 E922FD    1771 EVENT_T_OUT:  JMP RANDOM_MODORI
                1772 ;
1BD6 E850FA    1773 EVENT_EVENT:  CALL EVENT_TO_BASIC
1BD9 E8A2FA    1774      CALL VIEW_TBL_LED
1BDC E810F6    1775      CALL RUN_CONVERTER
1BDF E8C9F8    1776      CALL SPU_LED_DISP
1BE2 E9EEFC    1777      JMP NEXT_END
                1778 ;
1BE5 E8B600    1779 EVENT_AUTHO:  CALL KEIYAKU          ; Pay Channel Shinki Keiyaku
1BE8 B85541    1780      MOV AX,ASCII_AU
1BE8 E90800    1781      JMP EVENT_MSG
                1782 ;
1BEE E8CB00    1783 EVENT_CLEAR:  CALL KAIYAKU
1BF1 7319      1784      JNC EVENT_NO
1BF3 B84564    1785      MOV AX,ASCII_DE
1BF6 E8ABF8    1786 EVENT_MSG:  CALL SPU_LED_AX
1BF9 E84AFA    1787      CALL TIMER_1_SEC
                1788 ;
1BFC E8BBFB    1789      CALL NEXT_CONTINUE
                1790 ;
1BFF EB94      1791      JMP EV_PC_OK_YO
                1792 ;
1C01 E80A01    1793 EVENT_PLUS:  CALL UP_YOYAKU
1C04 E90300    1794      JMP EVENT_UD
1C07 E84E01    1795 EVENT_MINUS: CALL DOWN_YOYAKU
1C0A 7353      1796 EVENT_UD:  JNC FORCED_EVENT
1C0C E918FD    1797 EVENT_NO:  JMP MSG_NO_UT_END
                1798 ;
1C0F B780      1799 RANDOM_YOYAKU: MOV BH,0
1C11 8A1E2807 1800      MOV BL,[IC_BYTE]
1C15 8BF3      1801      MOV SI,BX
1C17 E8A402    1802      CALL KEY_BUFF_ADRS
1C1A 8800      1803      MOV [BX][SI],AL
                1804 ;
1C1C A28507    1805      MOV [MSB_LED],AL
1C1F B088      1806      MOV AL,88H          ; LSB = " "
1C21 A28407    1807      MOV [LSB_LED],AL
1C24 E8F8F8    1808      CALL SPU_LED_FLASH
1C27 E828FA    1809      CALL TIMER_5_SEC
                1810 ;
1C2A E88DFB    1811      CALL NEXT_CONTINUE          ; [[[ Key Input Wait ]]]
                1812 ;
1C2D A08907    1813      MOV AL,[KEY_DATA]
1C30 E8D1F4    1814      CALL KAZUKO
1C33 7249      1815      JC IRC_YOYAKU
1C35 B700      1816      MOV BH,0
1C37 8A1E2807 1817      MOV BL,[IC_BYTE]
1C3B 8BF3      1818      MOV SI,BX
1C3D E87E02    1819      CALL KEY_BUFF_ADRS
1C40 8A20      1820      MOV AH,[SI][BX]
                1821 ;
                1822      MOV [LSB_LED],AL          ; LED Display
1C42 A28407    1823      MOV [MSB_LED],AH
1C45 88268507 1824      CALL KEY_BUFF_ADRS
1C49 E87202

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1C4C 894004      1825      MOV [SI][BX+4],AX      ;
1C4F E0CDF8      1826      CALL SPU_LED_FLASH      ;
1C52 EB41FA      1827      CALL LED_BIN_BX
                        1828 ;
1C55 8B362807     1829      MOV SI,[IC_BYTE]
1C59 81C6000A     1830      ADD SI,HELP
1C5D 8B1C         1831      MOV [SI],BL
                        1832 ;
1C5F E83000      1833 FORCED_EVENT: CALL EV_FREQ_ADRS
1C62 833C00      1834      CMP WORD PTR [SI],0
1C65 7417         1835      JZ IRG_YOYAKU      ; Housou Sarateiassen
1C67 833C01      1836      CMP WORD PTR [SI],1
1C6A 740C         1837      JZ EVENT_RT1
                        1838 ;
1C6C E86D00      1839      CALL PAY_CH_MIRU      ; [[ Pay Channel Tuning ]]
1C6F E839F8      1840      CALL SPU_LED_DISP      ; [[ Pay ]]
1C72 E80E01      1841      CALL EVENT_BIN_TBL
1C75 E933FF      1842      JMP EVENT_KEY_WAIT
                        1843 ;
1C78 E8A4F8      1844 EVENT_RT1:  CALL SPU_LED_FLASH
1C7B E92DFF      1845      JMP EVENT_KEY_WAIT
                        1846 ;
1C7E E996FC      1847 IRG_YOYAKU:  JMP WT_NO_WT_END
                        1848 ;
                        1849 ; ***** SI = ES_EVENT_TIMER + [CONV_NO] * 128 + Channel
                        1850 ;
1C81 8B362407     1851 ES_PAY_STATUS: MOV SI,[CONV_NO]
1C85 8107         1852      MOV CL,7
1C87 03C6         1853      ROL SI,CL
1C89 81C60006     1854      ADD SI,ES_EVENT_TIMER      ; Timer Address
1C8D 03361E07     1855      ADD SI,[BINARY_LED]      ; Channel
1C91 C3          1856      RET
                        1857 ;
1C92 8E0009      1858 EV_FREQ_ADRS: MOV SI,EVENT_NO_FREQ
1C95 03361E07     1859      ADD SI,[BINARY_LED]
1C99 03361E07     1860      ADD SI,[BINARY_LED]
1C9D C3          1861      RET
                        1862 ;
1C9E 8B362807     1863 KEIYAKU:  MOV SI,[IC_BYTE]
1CA2 81C6000A     1864      ADD SI,HELP
1CA6 8A1C         1865      MOV BL,[SI]
1CA8 B700         1866      MOV BH,0
1CAA 891E1E07     1867      MOV [BINARY_LED],BX
1CAE E8D0FF      1868      CALL ES_PAY_STATUS
1CB1 268024F8     1869      AND BYTE PTR ES:[SI],0F8H
1CB5 A02A07      1870      MOV AL,[DEVICE_NO]
1CB8 260804      1871      OR ES:[SI],AL
1CBB C3          1872      RET
1CBC 8B362807     1873 KAIYAKU:  MOV SI,[IC_BYTE]
1CC0 81C6000A     1874      ADD SI,HELP
1CC4 8A1C         1875      MOV BL,[SI]
1CC6 B700         1876      MOV BH,0
1CC8 891E1E07     1877      MOV [BINARY_LED],BX
1CCC E8B2FF      1878      CALL ES_PAY_STATUS
1CCF 26803CF8     1879      CMP BYTE PTR ES:[SI],0F8H
1CD3 7306         1880      JNC KAIYAKU_ERR
1CD5 268024F8     1881      AND BYTE PTR ES:[SI],0F8H

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

1CD9 F9	1882	STC
1CDA C3	1883	RET
1CDB C3	1884 KAIYAKU_ERR:	RET
	1885 ;	
1CDC E8A2FF	1886 PAY_CH_MIRU:	CALL ES_PAY_STATUS
1CDF B480	1887	MOV AH,80H
1CE1 26803CF8	1888	CMP BYTE PTR ES:[SI],0F8H
1CE3 7202	1889	JC HATU
1CE7 B4C0	1890	MOV AH,0C0H
	1891 ;	
1CE9 0A262E07	1892 HATU:	OR AH,[CONV_NO_BIT]
1CED 802680073F	1893	AND BYTE PTR [NOW_EVENT],3FH
1CF2 08268007	1894	OR [NOW_EVENT],AH
1CF6 E8F6F4	1895	CALL RUN_CONVERTER
1CF9 C3	1896	RET
	1897 ;	
1CFA BE000A	1898 YOYAKU_SEARCH:	MOV SI,HELP
1CFD 03362807	1899	ADD SI,[IC_BYTE]
1D01 B700	1900	MOV BH,0
1D03 8A1C	1901	MOV BL,[SI]
1D05 83FB00	1902	CMP BX,0
1D08 740F	1903	JZ UP_WAKELARI
1D0A 4B	1904	DEC BX
1D0B E90B00	1905	JMP UP_WAKELARI
	1906 ;	
1D0E BE000A	1907 UP_YOYAKU:	MOV SI,HELP
1D11 03362807	1908	ADD SI,[IC_BYTE]
1D15 B700	1909	MOV BH,0
1D17 8A1C	1910	MOV BL,[SI]
1D19 8B362407	1911 UP_WAKELARI:	MOV SI,[CONV_NO]
1D1D B107	1912	MOV CL,7
1D1F D3E6	1913	ROL SI,CL
1D21 81C60006	1914	ADD SI,ES_EVENT_TIMER
1D25 B164	1915	MOV CL,100
1D27 43	1916 UYL:	INC BX
1D28 83FB64	1917	CMP BX,100
1D2B 7203	1918	JC UYJ
1D2D BB0100	1919	MOV BX,1
1D30 26F60007	1920 UYJ:	TEST BYTE PTR ES:[SI][BX],7
1D34 7506	1921	JNZ UD_Y_RET
1D36 FEC9	1922	DEC CL
1D38 75ED	1923	JNZ UYL
1D3A F9	1924	STC
1D3B C3	1925	RET
	1926 ;	
1D3C 891E1E07	1927 UD_Y_RET:	MOV [BINARY_LED],BX
1D40 E825FA	1928	CALL BINDEC_LED
	1929 ;	
1D43 BE3000	1930	MOV SI,EVENT_CHANNEL
1D46 03362407	1931	ADD SI,[CONV_NO]
1D4A 881C	1932	MOV [SI],BL
	1933 ;	
1D4C 8B362807	1934	MOV SI,[IC_BYTE]
1D50 81C6000A	1935	ADD SI,HELP
1D54 881C	1936	MOV [SI],BL
1D56 F8	1937	CLC
1D57 C3	1938	RET

HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1939 ;
1940
1941 DOWN_YOYAKU:  MOV SI,HELP
1942                ADD SI,[IC_BYTE]
1943                MOV BL,[SI]
1944                MOV BH,0
1945                MOV SI,[CONV_NO]
1946                MOV CL,7
1947                ROL SI,CL
1948                ADD SI,ES_EVENT_TIMER
1949                MOV CL,100
1950 DYL:           DEC BX
1951                JNZ DYJ
1952                MOV BX,99
1953 DYJ:           TEST BYTE PTR ES:[SI][BX],7
1954                JNZ UD_Y_RET
1955                DEC CL
1956                JNZ DYL
1957                STC
1958                RET
1959 ;
1960 EVENT_BIN_TBL: MOV AL,[BINARY_LED]
1961                MOV SI,EVENT_CHANNEL
1962                ADD SI,[CONV_NO]
1963                MOV [SI],AL
1964                RET
1965 ;
1966 ;
1967 ;-----
1968 ;
1969 ;           Another Subroutines
1970 ;
1971 ;-----
1972 ;
1973
1974 ANGO_TOUROKU:  POP AX
1975                MOV SI,NEXT_GO_ADRS
1976                MOV BH,0
1977                MOV BL,[IC_BYTE]
1978                ADD BL,BL
1979                MOV [SI][BX],AX
1980 ;
1981 ANGO_1_10:     MOV AX,ASCII_NU
1982                CALL SPU_LED_AX
1983                CALL TIMER_10_SEC
1984 ;
1985                CALL NEXT_CONTINUE
1986 ;
1987                CALL ANGO_SUB
1988                JNC ANGO_1_20
1989                CMP AL,CLEAR_KEY_CODE
1990                JNZ ANGO_ERR
1991                JMP RANDOM_MODORI
1992 ANGO_1_20:     MOV [SI][BX],AL
1993 ANGO_1_21:     MOV AL,[SI][BX]
1994                MOV [LSB_LED],AL
1995                MOV AH,20H

```



HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1DBF E80E01      1996      CALL ANGO_SUB1
                  1997 ;
1DC2 E8F5F9      1998      CALL NEXT_CONTINUE
                  1999 ;
1DC5 E8E100      2000      CALL ANGO_SUB
1DC8 7306        2001      JNC ANGO_1_30
1DCA 3C16        2002      CMP AL,CLEAR_KEY_CODE
1DCC 7556        2003      JNZ ANGO_ERR
1DCE EBCE        2004      JMP ANGO_1_10
1DD0 884001      2005 ANGO_1_30:  MOV [SI][BX+1],AL
1DD3 8A4001      2006 ANGO_1_31:  MOV AL,[SI][BX+1]
1DD6 A28407      2007      MOV [LSB_LED],AL
1DD9 8A20        2008      MOV AH,[SI][BX]
1DDB E8F200      2009      CALL ANGO_SUB1
                  2010 ;
1DDE E8D9F9      2011      CALL NEXT_CONTINUE
                  2012 ;
1DE1 E8C500      2013      CALL ANGO_SUB
1DE4 7306        2014      JNC ANGO_1_40
1DE6 3C16        2015      CMP AL,CLEAR_KEY_CODE
1DE8 75E9        2016      JNZ ANGO_1_31
1DEA EBCC        2017      JMP ANGO_1_21
1DEC 884002      2018 ANGO_1_40:  MOV [SI][BX+2],AL
1DEF 8A4002      2019 ANGO_1_41:  MOV AL,[SI][BX+2]
1DF2 A28407      2020      MOV [LSB_LED],AL
1DF5 8A6001      2021      MOV AH,[SI][BX+1]
1DF8 E8D500      2022      CALL ANGO_SUB1
                  2023 ;
1DFB E8BCF9      2024      CALL NEXT_CONTINUE
                  2025 ;
1DFE E8A800      2026      CALL ANGO_SUB
1E01 7306        2027      JNC ANGO_1_RET
1E03 3C16        2028      CMP AL,CLEAR_KEY_CODE
1E05 751D        2029      JNZ ANGO_ERR
1E07 EBCA        2030      JMP ANGO_1_31
1E09 884003      2031 ANGO_1_RET:  MOV [SI][BX+3],AL
1E0C A28407      2032      MOV [LSB_LED],AL
1E0F 8A6002      2033      MOV AH,[SI][BX+2]
1E12 E8B800      2034      CALL ANGO_SUB1
                  2035 ;
1E15 BE0004      2036      MOV SI,NEXT_CO_ADRS
1E18 B700        2037      MOV BH,0
1E1A 8A1E2807    2038      MOV BL,[IC_BYTE]
1E1E 02DB        2039      ADD BL,BL
1E20 8B00        2040      MOV AX,[SI][BX]
1E22 50          2041      PUSH AX
1E23 C3          2042      RET
                  2043 ;
                  2044 ;
                  2045 ;
1E24 E9B8FA      2046 ANGO_ERR:  JMP MSGERR_UT_END
                  2047 ;
                  2048 ;
                  2049 ;
1E27 58          2050 ANGO_INPUT:  POP AX
1E28 BE0004      2051      MOV SI,NEXT_CO_ADRS
1E2B B700        2052      MOV BH,0

```

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

1E2D 8A1E2807	2053	MOV BL,[IC_BYTE]
1E31 02DB	2054	ADD BL,BL
1E33 8900	2055	MOV [SI][BX],AX
	2056 ;	
1E35 B8B6B6	2057 ANGO_2_10:	MOV AX,0B6B6H
1E38 EB69F6	2058	CALL SPU_LED_AX
1E3B EB1AF8	2059	CALL TIMER_10_SEC
	2060 ;	
1E3E EB79F9	2061	CALL NEXT_CONTINUE
	2062 ;	
1E41 EB6500	2063 ANGO_2_11:	CALL ANGO_SUB
1E44 7307	2064	JNC ANGO_2_20
1E46 3C16	2065	CMP AL,CLEAR_KEY_CODE
1E48 75DA	2066	JNZ ANGO_ERR
1E4A E9ABFA	2067	JMP RANDOM_MOD0R1
1E4D 8800	2068 ANGO_2_20:	MOV [SI][BX],AL
1E4F B8B6B6	2069 ANGO_2_21:	MOV AX,0B6B6H
1E52 E88900	2070	CALL ANGO_SUB2
	2071 ;	
1E55 E862F9	2072	CALL NEXT_CONTINUE
	2073 ;	
1E58 E84E00	2074	CALL ANGO_SUB
1E5B 7306	2075	JNC ANGO_2_30
1E5D 3C16	2076	CMP AL,CLEAR_KEY_CODE
1E5F 75C3	2077	JNZ ANGO_ERR
1E61 EBD2	2078	JMP ANGO_2_10
1E63 884001	2079 ANGO_2_30:	MOV [SI][BX+1],AL
1E66 B8B620	2080 ANGO_2_31:	MOV AX,20B6H
1E69 EB7200	2081	CALL ANGO_SUB2
	2082 ;	
1E6C E84BF9	2083	CALL NEXT_CONTINUE
	2084 ;	
1E6F E83700	2085	CALL ANGO_SUB
1E72 7306	2086	JNC ANGO_2_40
1E74 3C16	2087	CMP AL,CLEAR_KEY_CODE
1E76 75AC	2088	JNZ ANGO_ERR
1E78 EBD3	2089	JMP ANGO_2_21
1E7A 884002	2090 ANGO_2_40:	MOV [SI][BX+2],AL
1E7D B8B620	2091 ANGO_2_41:	MOV AX,20B6H
1E80 E85B00	2092	CALL ANGO_SUB2
	2093 ;	
1E83 E834F9	2094	CALL NEXT_CONTINUE
	2095 ;	
1E86 E82000	2096	CALL ANGO_SUB
1E89 7306	2097	JNC ANGO_2_RET
1E8B 3C16	2098	CMP AL,CLEAR_KEY_CODE
1E8D 7595	2099	JNZ ANGO_EPP
1E8F EBD3	2100	JMP ANGO_2_31
1E91 884003	2101 ANGO_2_RET:	MOV [SI][BX+3],AL
1E94 B82020	2102	MOV AX,2020H
1E97 E84400	2103	CALL ANGO_SUB2
	2104 ;	
1E9A BE0004	2105	MOV SI,NEXT_GO_ADRS
1E9D 8700	2106	MOV BH,0
1E9F 8A1E2807	2107	MOV BL,[IC_BYTE]
1EA3 02DB	2108	ADD BL,BL
1EA5 8B00	2109	MOV AX,[SI][BX]

## HEWLETT-PACKARD: 8086 Assembler

## SOURCE LINE

```

1EA7 50      2110      PUSH AX
1EAB C3      2111      PET
               2112 ;
               2113 ;
               2114 ;
1EA9 A08907  2115 ANGO_SUB:  MOV AL,[KEY_DATA]
1EAC E855F2  2116      CALL KAZUKO
1EAF 730D    2117      JNC KEY_BUFF_ADRS
1EB1 3C00    2118      CMP AL,TIMER_OUT_CODE
1EB3 7504    2119      JNZ KAORU
1EB5 58      2120      POP AX
1EB6 E93FFA  2121      JMP RANDOM_MODORI
1EB9 E90200  2122 KAORU:   CALL KEY_BUFF_ADRS
1EBC F9      2123      STC
1EBD C3      2124      RET
               2125 ;
1EBE 8E0010  2126 KEY_BUFF_ADRS: MOV SI,KEY_DATA_STACK
1EC1 8700    2127      MOV BH,0
1EC3 8A1E2807 2128      MOV BL,[IC_BYTE]
1EC7 03DB    2129      ADD BX,BX
1EC9 03DB    2130      ADD BX,BX
1ECB 03DB    2131      ADD BX,BX
1ECD 03DB    2132      ADD BX,BX
1ECF C3      2133      RET
               2134 ;
1ED0 88268507 2135 ANGO_SUB1:  MOV [MSB_LED],AH
1ED4 E8BDF4  2136      CALL SPU_CLEAR_DISP
1ED7 E8D1F5  2137      CALL SPU_LED_DISP
1EDA E87BF7  2138      CALL TIMER_10_SEC
1EDD C3      2139      RET
               2140 ;
1EDE E8C3F5  2141 ANGO_SUB2:  CALL SPU_LED_AX
1EE1 E874F7  2142      CALL TIMER_10_SEC
1EE4 C3      2143      RET
               2144 ;
1EE5 E9D6FF  2145 ANGO_BIN_DX:  CALL KEY_BUFF_ADRS
1EE8 B500    2146      MOV CH,0
1EEH 84F5    2147      MOV DH,CH
1EEC 8A10    2148      MOV DL,[SI+1][BX]      ; DX = #1
1EEE 80E20F  2149      AND DL,0FH
1EF1 E91F00  2150      CALL MULTI_10_DX      ; DX = #1*10
1EF4 8A4801  2151      MOV CL,[SI+1][BX]
1EF7 80E10F  2152      AND CL,0FH
1EFA 03D1    2153      ADD DX,CX              ; DX = #1*10+#2
1EFC E91400  2154      CALL MULTI_10_DX      ; DX = (#1*10+#2)*10
1EFF 8A4802  2155      MOV CL,[SI+2][BX]
1F02 80E10F  2156      AND CL,0FH
1F05 03D1    2157      ADD DX,CX              ; DX = (#1*10+#2)*10+#3
1F07 E8A900  2158      CALL MULTI_10_DX      ; DX = (#1*10+#2)*10+#3*10
1F0A 8A4803  2159      MOV CL,[SI+3][BX]
1F0D 80E10F  2160      AND CL,0FH
1F10 03D1    2161      ADD DX,CX              ; DX = ((#1*10+#2)*10+#3)*10+#4
1F12 C3      2162      RET
               2163 ;
1F13 03D2    2164 MULTI_10_DX:  ADD DX,DX      ; *2
1F15 8BC2    2165      MOV AX,DX
1F17 03C0    2166      ADD AX,AX      ; *2*2 = *4

```

## HEWLETT-FWCKAPD: 8086 Assembler

## SOURCE LINE

```

1F19 03C0      2167      ADD AX,AX      : *2+2+2 = *8
1F1B 03D0      2168      ADD DX,AX      ; *2 + *8 = *10
1F1D C3        2169      RET
                2170 ;
                2171 ; ***** Key In Shita Angou Wo Display Suru *****
                2172 ;
1F1E 58        2173 ANGO_DISPLAY: POP AX
1F1F BE0004     2174      MOV SI,NEXT_GO_ADRS
1F22 8700      2175      MOV BH,0
1F24 8A1E2807   2176      MOV BL,[IC_BYTE]
1F28 02DB      2177      ADD BL,BL
1F2A 8900      2178      MOV [SI][BX],AX
                2179 ;
1F2C E89FFF     2180      CALL KEY_BUFF_ADRS
1F2F C6400700   2181      MOV BYTE PTR [SI][BX+7],0
                2182 ;
1F33 885541     2183 ANGO_AU_WT_LP: MOV AX,ASCII_AU
1F36 E86BF5     2184      CALL SPU_LED_AX
1F39 E80AF7     2185      CALL TIMER_1_SEC
                2186 ;
1F3C E87BF8     2187      CALL NEXT_CONTINUE
                2188 ;
1F3F A08907     2189      MOV AL,[KEY_DATA]
1F42 3C12      2190      CMP AL,AUTHO_KEY_CODE
1F44 7476      2191      JZ ANGO_NINTEI
1F46 3C16      2192      CMP AL,CLEAR_KEY_CODE
1F48 7462      2193      JZ ANGO_NO_AUTHO
1F4A E871FF     2194      CALL KEY_BUFF_ADRS
1F4D FE4007     2195      INC BYTE PTR [SI][BX+7]
1F50 B020      2196      MOV AL,20H
1F52 A28507     2197      MOV [MSB_LED],AL
1F55 8A80      2198      MOV AL,[SI][BX]
1F57 A28407     2199      MOV [LSB_LED],AL
1F5A E84EF5     2200      CALL SPU_LED_DISP
1F5D E8E6F6     2201 ANGO_DISP_LP: CALL TIMER_1_SEC
                2202 ;
1F60 E857F8     2203      CALL NEXT_CONTINUE
                2204 ;
1F63 A08907     2205      MOV AL,[KEY_DATA]
1F66 3C12      2206      CMP AL,AUTHO_KEY_CODE
1F68 7452      2207      JZ ANGO_NINTEI
1F6A 3C16      2208      CMP AL,CLEAR_KEY_CODE
1F6C 743E      2209      JZ ANGO_NO_AUTHO
1F6E E84DFF     2210      CALL KEY_BUFF_ADRS
1F71 8A6007     2211      MOV AH,[SI][BX+7]
1F74 80E403     2212      AND AH,3
1F77 0ADC      2213      OR BL,AH
1F79 8A40FF     2214      MOV AL,[SI][BX-1]
1F7C A28507     2215      MOV [MSB_LED],AL
1F7F 8A00      2216      MOV AL,[SI][BX]
1F81 A28407     2217      MOV [LSB_LED],AL
1F84 E80DF4     2218      CALL SPU_CLEAR_DISP
1F87 E821F5     2219      CALL SPU_LED_DISP
                2220 ;
1F8A E831FF     2221      CALL KEY_BUFF_ADRS
1F8D FE4007     2222      INC BYTE PTR [SI][BX+7]
1F90 8A6007     2223      MOV AH,[SI][BX+7]

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## SOURCE LINE

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1F93 80FC96      2224      CMP AH,150
1F96 7314        2225      JNC ANGO_NO_AUTHO
1F98 80E403      2226      AND AH,3
1F9B 75C0        2227      JNZ ANGO_DISP_LP
1F9D E8A6F6      2228 ANGO_AU_RETRY: CALL TIMER_1_SEC
                  2229 ;
1FA0 E817F8      2230      CALL NEXT_CONTINUE
                  2231 ;
1FA3 A08907      2232      MOV AL,[KEY_DATA]
1FA6 3C12        2233      CMP AL,AUTHO_KEY_CODE
1FA8 7412        2234      JZ ANGO_MINTEI
1FAA EB97        2235      JMP ANGO_AU_UT_LP
                  2236 ;
1FAC BE0004      2237 ANGO_NO_AUTHO: MOV SI,NEXT_CO_ADRS
1FAF B700        2238      MOV BH,0
1FB1 8A1E2807    2239      MOV BL,[IC_BYTE]
1FB5 02DB        2240      ADD BL,BL
1FB7 8B00        2241      MOV AX,[SI][BX]
1FB9 50          2242      PUSH AX
1FBA F9          2243      STC
1FBB C3          2244      RET
                  2245 ;
1FBC BE0004      2246 ANGO_MINTEI:  MOV SI,NEXT_CO_ADRS
1FBF B700        2247      MOV BH,0
1FC1 8A1E2807    2248      MOV BL,[IC_BYTE]
1FC5 02DB        2249      ADD BL,BL
1FC7 8B00        2250      MOV AX,[SI][BX]
1FC9 50          2251      PUSH AX
1FCA F8          2252      CLC
1FCB C3          2253      RET
                  2254 ;
                  2255 ;
                  2256 ;
1FCC 3C88        2257 PAY_GROUP_1:  CMP AL,88H
1FCE 7406        2258      JZ PAY_PROG_START
1FD0 3C8A        2259      CMP AL,8AH
1FD2 7478        2260      JZ PAY_PROG_STOP
1FD4 F8          2261      CLC
1FD5 C3          2262      RET
                  2263 ;
1FD6 8A4405      2264 PAY_PROG_START: MOV AL,[SI+5] ; Channel
1FD9 B400        2265      MOV AH,0
1FDB 8B5406      2266      MOV DX,[SI+6] ; DX = Freq. Data
1FDE BB0009      2267      MOV BX,EVENT_NO_FREQ
1FE1 03D8        2268      ADD BX,AX
1FE3 03D8        2269      ADD BX,AX ; BX = Freq. Table address
1FE5 8917        2270      MOV [BX],DX ; Frequency Set
                  2271 ;
1FE7 BA0000      2272      MOV DX,0
1FEA BB0006      2273      MOV BX,ES_EVENT_TIMER
1FED 03D8        2274      ADD BX,AX
                  2275 ;
1FEF 83FA06      2276 EV_F_ST_CHK:  CMP DX,6
1FF2 7356        2277      JNC P_F_START_RET
                  2278 ;
1FF4 26F60707    2279      TEST BYTE PTR ES:[BX],7
1FF8 7449        2280      JZ NEXT_EV_ST

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## SOURCE LINE

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2281 ;
1FFA 30      2282      PUSH AX          : Channel
1FFB 53      2283      PUSH BX          : N th Converter  Event Timer Addr
1FFC 52      2284      PUSH DX          : Drop No.
2285
1FFD A31E07  2286      MOV [BINARY_LED],AX
2000 88162407 2287      MOV [CONV_NO],DL
2004 268A07   2288      MOV AL,ES:[BX]
2007 2407     2289      AND AL,7
2009 7502     2290      JNZ DEV_OK
200B 8002     2291      MOV AL,2
2292 ;
200D A22A07   2293 DEV_OK:  MOV [DEVICE_NO],AL
2010 02C0     2294      ADD AL,AL
2012 02C0     2295      ADD AL,AL
2014 02C0     2296      ADD AL,AL          ; AL * 8
2016 02D0     2297      ADD DL,AL
2018 88162807 2298      MOV [IC_BYTE],DL
201C E81AF0   2299      CALL CONV_TO_DROP
201F E884F0   2300      CALL ID_DROP_DEVICE
2022 E88FF3   2301      CALL SPU_RELAY_ON
2025 8B1E1E07 2302      MOV BX,[BINARY_LED]
2029 E83CF7   2303      CALL BINDEC_LED
2304 ;
202C BE8003   2305      MOV SI,JUMP_ADDRESS
202F 03362807 2306      ADD SI,[IC_BYTE]
2033 03362807 2307      ADD SI,[IC_BYTE]
2037 8B161A07 2308      MOV DX,[BASE_POINT]
203B 8914     2309      MOV [SI],DX
2310 ;
203D E81FFC   2311      CALL FORCED_EVENT
2312 ;
2040 5A       2313      POP DX
2041 5B       2314      POP BX
2042 58       2315      POP AX
2043 42       2316 NEXT_EV_ST: INC DX
2044 81C38000 2317      ADD BX,128
2048 EBA5     2318      JMP EV_F_ST_CX
2319 ;
204H F8       2320 P_P_START_RET: CLC
204B C3       2321      RET
2322 ;
204C 90       2323 PAY_PROG_STOP: NOP
204D F8       2324 PAY_GROUP_2: CLC
204E C3       2325      RET
2326 ;
2327 ;
2328 ;
2329
2330      GLOBAL      POWER_DET_CMD
2331      GLOBAL      LOAD_FROM_DROP
2332      GLOBAL      LOAD_TO_DROP
2333      GLOBAL      SPU_STATUS_REQ
2334      GLOBAL      ID_DROP_DEVICE
2335      GLOBAL      IC_DROP_DEVICE
2336      GLOBAL      CONV_SU_BIT_AL
2337      GLOBAL      DROP_BIT_AL
2337      GLOBAL      SPU_RELAY_OFF

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## SOURCE LINE

2338	GLOBAL	SPU_CLEAR_DISP
2339	GLOBAL	EVENT_LED_OFF
2340	GLOBAL	DROP_MAP_SET
2341	GLOBAL	KEY_OPERATION
2342	GLOBAL	CONV_TO_DROP
2343	GLOBAL	DROP_TO_CONV
2344	GLOBAL	BINDEC_LED
2345	GLOBAL	LED_VIEW_TBL
2346	GLOBAL	SPU_LED_DISP
2347	GLOBAL	RUN_CONVERTER
2348	GLOBAL	WAKEARI_DE_ON
2349	GLOBAL	OP_SPU_OFF
2350	GLOBAL	OP_INITIAL
2351	GLOBAL	BASE_ROUTINE
2352	GLOBAL	JUMP_ADRS_INIT
2353	GLOBAL	JUMP_ADRS_INIZ
2354	GLOBAL	DEVICE_MAP_SET
2355	GLOBAL	PAY_GROUP_1
2356	GLOBAL	PAY_GROUP_2
2357 ;		
2358 ;		
2359 ;		
2360	EXTRN	SPECIAL_SPU_1
2361		
2362		
2363		
2364		
2365		

Errors 0

What Is Claimed Is:

1. A cable television system for providing selected television signals to a plurality of remotely located subscriber premises, having a head end for producing a television signal and a cable network for conducting the television signal from the head end to a plurality of remote locations, each of which is adjacent but external to a respective subset of the subscriber premises, comprising:

external control unit means at each of the remote locations for receiving the television signal from the cable network;

a plurality of drop cables connected to each external control unit means, each drop cable conducting a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber device means connected to each drop cable at the subscriber premises for applying to the drop cable a first control signal indicative of data to be transmitted to the external control unit means, at least one of said subscriber device means being a subscriber processing unit means for allowing the subscriber to apply to the drop cable a first control signal including channel data indicative of the portion of the television signal which that subscriber wishes to select; and

first means associated with each external control unit means for processing the first control signals applied to all the drop cables associated with that external control unit means and for causing that external control unit means to apply to each associated drop cable the portion of the television signal indicated by the first control signal



channel data received via the drop cable, the first means including common signal processing circuitry which at least partially processes the information represented by the first control signals applied to all of the drop cables associated with that external control unit means.

2. The apparatus defined in claim 1, further comprising:

second means associated with each external control unit means for applying to each drop cable a second control signal indicative of data to be transmitted to the associated subscriber premises; and

third means associated with each subscriber processing unit means for processing the second control signal to receive and store the data indicated by the second control signal.

3. The apparatus defined in claim 2, wherein: said subscriber processing unit means includes a character display means;

the second control signal applied to each drop cable includes character display data; and

said subscriber processing unit means includes fourth means responsive to the received and stored second control signal for controlling the character display means in accordance with the character display data indicated by the second control signal.

4. The apparatus defined in claim 3, wherein the character display data indicated by the second control signal applied to each drop cable are indicative of the selected portion of the television signal applied to that drop cable by the external control unit means.

5. The apparatus defined in claim 2, further comprising:

fourth means associated with the head end for applying to the cable network a third control signal indicative of data to be transmitted to at least one external control unit means; and

fifth means associated with each external control unit means for processing the third control signal to receive and store the data indicated by the third control signal.

6. The apparatus defined in claim 2, further comprising:

sixth means associated with each external control unit means for applying to the cable network a fourth control signal indicative of data to be transmitted to the head end; and

seventh means associated with the head end for processing the fourth control signal to receive and store the data indicated by the fourth control signal.

7. The apparatus defined in claim 5, further comprising:

sixth means associated with each external control unit means for applying to the cable network a fourth control signal indicative of data to be transmitted to the head end; and

seventh means associated with the head end for processing the fourth control signal to receive and store the data indicated by the fourth control signal.

8. The apparatus defined in claim 5, wherein:

said fifth means associated with each external control unit means includes eighth means for producing address signal information which uniquely identifies the associated external control unit means;

the third control signal includes address signal data indicative of at least one external control unit means to which the third control signal is to be transmitted; and

said fifth means associated with each external control unit means includes ninth means for comparing the received address signal data to the associated address signal information, and enabling the associated fifth means to store the data indicated by the third control signal if the received address signal data bear a predetermined relationship to the associated address signal information.

9. The apparatus defined in claim 8, wherein said ninth means associated with each external control unit means enables said fifth means to store the data indicated by the third control signal if the received address signal data correspond to the associated address signal information.

10. The apparatus defined in claim 5, wherein:

the third control signal includes broadcast address signal data indicative of all external control unit means; and

said fifth means associated with each external control unit means includes tenth means for recognizing the broadcast address signal data, and enabling the associated fifth means to store the data indicated by the third control signal if the received broadcast address signal data is recognized.

11. The apparatus defined in claim 5,  
wherein:

the third control signal includes channel authorization data indicative of the portions of the television signal which at least one subscriber associated with that external control unit means is authorized to select; and

said fifth means associated with each external control unit means includes eleventh means for causing said external control unit means to apply to each associated drop cable the portion of the television signal indicated by the first control signal channel data received via the drop cable only if the stored channel authorization data indicates that the subscriber associated with the drop cable is authorized to receive that portion of the television signal.

12. The apparatus defined in claim 5,  
wherein:

the third control signal includes channelization data indicative of a desired correlation between each portion of the television signal which can be selected by the subscriber and the channel data indicated by the first control signal used to select each portion of the television signal; and

said fifth means associated with each external control unit means includes twelfth means responsive to the channelization data for causing the external control unit means to apply to each associated drop cable the correlated portion of the television signal indicated by the first control signal channel data received via the drop cable.

13. The apparatus defined in claim 5,  
wherein:

the third control signal includes force tune data indicative of a portion of the television signal for transmission to the subscriber premises; and

said fifth means associated with each external control unit means includes thirteenth means responsive to the force tune data for causing said external control unit means to apply to the associated drop cables the portion of the television signal indicated by the force tune data.

14. The apparatus defined in claim 13, wherein:

said second means associated with each external control unit means includes fourteenth means responsive to the force tune data for causing said second means to apply to the associated drop cables the second control signal;

the second control signal applied to each drop cable includes television on/off data; and

said subscriber processing unit means includes fifteenth means responsive to the second control signal for controlling on and off a television apparatus in accordance with the television on/off data.

15. The apparatus defined in claim 8, wherein: said fifth means associated with each external control unit means includes sixteenth means for storing data at one or more storage addresses;

the third control signal includes storage address data indicative of a storage address in said external control unit means; and

said fifth means associated with each external control unit means includes seventeenth means for causing said associated sixteenth means to store the data indicated by the second control signal

commencing at a storage address which bears a pre-determined relationship to the storage address data indicated by the third control signal.

16. The apparatus defined in claim 6, wherein: the first control signal includes data indicative of information to be transmitted from a subscriber device means to the head end;

said first means associated with each external control unit means includes eighteenth means to receive and store the information indicated by the first control signal;

the third control signal includes read data indicative of a request to transmit to the head end the information stored in said eighteenth means; and

said sixth means associated with said external control unit means includes nineteenth means responsive to the third control signal for enabling said sixth means to apply to the cable network the fourth control signal including data indicative of the stored information.

17. The apparatus defined in claim 6, wherein:

the first control signal includes data indicative of information to be transmitted to the head end;

said first means associated with each external control unit means includes twentieth means to accumulate and store the information indicated by the first control signals applied to all of the drop cables associated with that external control unit means;

the third control signal includes send function data indicative of a request to transmit to the head end the accumulated information stored in said twentieth means; and

said sixth means associated with said external control unit means includes twenty-first means responsive to the send function data of the third control signal for enabling said sixth means to apply to the cable network the fourth control signal including data indicative of the accumulated and stored information.

18. The apparatus of claim 5, wherein:  
the first control signal includes data indicative of a request to view a pay-per-view program event;

the third control signal includes pay-per-view program event data indicative of the transmission of a pay-per-view program event and the portion of the television signal corresponding to that pay-per-view program event; and

the fifth means associated with each external control unit means includes twenty-second means responsive to the pay-per-view program event data of the third control signal for applying to each associated drop cable the portion of the television signal indicated by the third control signal if the pay-per-view program event indicated by the third control signal corresponds to the pay-per-view program event request of the first control signal.

19. A cable television system for transmitting via a cable network television signals from a head end to a plurality of remote locations, and other signals between the head end and the plurality of remote locations, comprising:

means at each of the remote locations for receiving the television signals from the cable network;

first means associated with the head end for applying to the cable network a first control signal indicative of data to be transmitted to at least one receiving means, at least a portion of the first control signal being indicative of a particular one of a plurality of reverse channel frequency bands; and

second means associated with each receiving means for processing the first control signal and for applying to the cable network in any one of a plurality of reverse channel frequency bands a second control signal indicative of data to be transmitted to the head end, said second means being responsive to the first control signal for applying the second control signal in the reverse channel frequency band indicated by the first control signal.

20. The cable television system defined in claim 19, wherein each remote location is adjacent but external to a respective set of subscriber premises and wherein said receiving means comprises an external control unit means, said cable television system further comprising:

a plurality of drop cables connected to each external control unit means, each drop cable conducting a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber processing unit means connected to the drop cable at at least one of the subscriber premises for allowing the subscriber to apply to the drop cable a third control signal indicative



of the portion of the television signal which that subscriber wishes to select; and

processing means associated with each external control unit for processing the third control signals applied to all of the drop cables associated with that external control unit and for causing that external control unit means to apply to each associated drop cable the portion of the television signal indicated by the third control signals, the processing means including common signal processing circuitry which at least partially processes the information represented by the third control signals applied to all of the drop cables associated with that external control circuit means.

21. A cable television system for transmitting via a cable network television signals from a head end to a plurality of remote locations, and other signals between the head end and the plurality of remote locations, each remote location being adjacent but external to a set of subscriber premises, comprising:

addressable external control unit means at each of the remote locations for receiving the television signal from the cable network;

a plurality of drop cables connected to each external control unit means, each drop cable conducting a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber processing unit means connected to each drop cable at the subscriber's premises for allowing the subscriber to apply to the drop cable a first control signal indicative of the portion of the television signal which that subscriber wishes to select;

first means associated with each external control unit means for processing the first control signals applied to all of the drop cables associated with that external control unit means and for causing that external control unit means to apply to each associated drop cable the portion of the television signal indicated by the first control signal received via that drop cable, the first means including common signal processing circuitry which at least partially processes the information represented by the first control signals applied to all of the drop cables associated with that external control unit means;

second means associated with the head end means for applying to the cable network a second control signal indicative of data to be transmitted to at least one external control unit means, wherein at least a portion of the second control signal is indicative of an external control unit means address;

third means associated with each external control unit means for processing the second control signal to receive and store the data indicated by the second control signal if the second control signal is addressed to the external control unit means; and

handshaking means associated with each external control unit means and responsive to the third means to apply to the cable network for transmission to the head end a response signal indicative of whether or not the external control unit means received the second control signal without error.

22. A cable television system for transmitting via a cable network television signals from a head end to a plurality of subscriber premises,

and other signals between the head end and the plurality of subscriber premises, comprising:

polling signal means associated with the head end for applying polling signals to the cable network;

external control unit means located at a plurality of remote locations, each location being adjacent but external to a subset of the subscriber premises, for receiving the television signals and the polling signals from the cable network;

a plurality of drop cables connected to each external control unit means for conducting selected portions of the television signals from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber processing unit means connected to each drop cable at the subscriber premises for allowing the subscriber to apply to the drop cable a control signal indicative of information to be transmitted to said external control unit means, including information indicating the portion of the television signal which that subscriber wishes to select and information for transmission to the head end;

control signal processing means associated with the external control unit for receiving and storing the information indicated by the control signals applied to all of the drop cables associated with that external control unit means and for applying to each drop cable the portion of the television signal indicated by the television signal selection information received via that drop cable; and

polling signal processing means associated with each external control unit means for processing the received polling signals and for responding thereto by applying a response signal to the cable network for transmission to the head end indicative of whether or not said external control unit means has information to transmit to the head end.

23. The cable television system defined in claim 22, wherein the polling signals include address signal data indicative of the external control unit means to which the polling signal is to be transmitted, and wherein the polling signal processing means further comprises:

means for producing address signal information which uniquely identifies the associated external control unit means; and

means for comparing the received address signal data to the associated address signal information and for causing the polling signal processing means to respond to the received polling signal if the received address signal data bear a predetermined relationship to the associated address signal information.

24. The cable television system defined in claim 23, wherein:

said external control unit means includes means for associating a level of importance with the information which the external control unit means has to transmit to the head end;

said polling signal means associated with the head end includes means for applying to the cable network response threshold level signal data indicative of the level at which said external

control unit means should respond to received polling signals; and

said polling signal processing means associated with each external control unit means includes means for comparing the received threshold level signal data to the level of the information which the external control unit means has to transmit to the head end, and for enabling the associated polling signal processing means to transmit a response signal to the head end indicating that the external control unit means has information to transmit to the head end if the level of information which said external control unit means has to transmit to the head end bears a predetermined relationship to the received response threshold level signal data.

25. The cable television system defined in claim 23, wherein:

said external control unit means includes means for associating a level of importance with the information which the external control unit means has to transmit to the head end;

said polling signal means associated with the head end includes means for applying a signal to the cable network for establishing a priority information window on the cable network, the priority information window signal including priority response threshold level signal data indicative of the priority information level at which said external control unit means should respond to the polling signals; and

said external control unit means includes means for receiving the priority information window signal and storing the priority response threshold level signal data, for comparing the priority response threshold level signal data to

the level of information which the external control unit means has to transmit to the head end, and for causing said polling signal processing means associated with said external control unit means to respond to any received polling signal whenever the information which the external control unit means has to transmit to the head end bears a predetermined relationship to the priority response threshold level signal data.

26. A two-way cable television system for transmitting television and other signals via a cable network from a head end to addressable terminal devices at a plurality of remote locations, comprising:

first means associated with the head end for transmitting polling signals to the addressable terminal devices, the polling signals including a terminal device address;

second means associated with the terminal devices for storing information and for assigning a level of importance to the stored information;

third means associated with the head end for transmitting to the terminal devices threshold level control signals indicative of the threshold level at which the terminal devices should transmit information to the head end;

fourth means associated with each terminal devices for receiving the threshold level control signals and for comparing the level of the information stored in the terminal device with the threshold level indicated by the threshold level control signals; and

fifth means responsive to said fourth means and to received polling signals addressed to

the terminal device for transmitting to the head end a response signal indicating that the terminal device has information to transmit to the head end if the level of the information bears a predetermined relationship to the threshold level indicated by the threshold level control signals.

27. A two-way cable television system for transmitting television signals and other signals via a cable network from a head end to addressable terminal devices at a plurality of remote locations, comprising:

first means associated with the head end for transmitting polling signals to the addressable terminal devices, the polling signals including a terminal device address;

second means associated with the terminal devices for storing information and for assigning a level of importance to the stored information;

third means associated with the head end for transmitting to the terminal devices priority information control signals indicative of the priority threshold level at which the terminal devices should transmit information to the head end;

fourth means associated with each terminal device for receiving the priority information control signals and for comparing the level of the information stored in the terminal device with the priority threshold level indicated by the priority information control signals; and

fifth means responsive to said fourth means and to any received polling signal for transmitting to the head end a response signal indicating that the terminal device has information to transmit to the head end if the level of the information bears

a predetermined relationship to the priority threshold level indicated by the priority information control signals.

28. The cable television of claim 27, wherein:

the priority information control signals include data indicative of a particular one of a plurality of reverse channels available for transmission of information from the terminal devices to the head end; and

the terminal devices include sixth means responsive to the priority information control signals for transmitting the response signal in the particular reverse channel indicated by the priority information control signal data.

29. A cable television system for transmitting television signals via a cable network from a head end to a plurality of remote locations, each remote location being adjacent but external to a selected set of subscriber premises, comprising:

external control unit means at each of the remote locations for receiving the television signals from the cable network;

a plurality of drop cables connected to at least one external control unit means, each drop cable conducting a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber device means connected to the drop cable at the subscriber premises for applying to the drop cable a service request signal indicative of a request by the subscriber device means to communicate with the external control unit means; and



drop polling means associated with the external control unit means for sensing in a predetermined order on each drop cable of the presence of the service request signal to enable the associated external control unit means to rapidly locate a drop cable on which a subscriber device means is requesting to communicate with the external control unit means.

30. The cable television system of claim 29, wherein said drop polling means includes a multiplexer means to selectively connect said drop polling means to each drop cable connected to the external control unit means.

31. The cable television system of claim 29, further comprising:

device polling means associated with the external control unit means, said device polling means being responsive to the drop polling means sensing the service request signal on a drop cable for applying a first control signal to that drop cable, the first control signal including data indicative of a subscriber device means address;

address means associated with each subscriber device means for producing address signal information which uniquely identifies the subscriber device means on the drop cable to which the subscriber device means is connected;

transmitter means associated with each subscriber device means for applying to its associated drop cable a second control signal indicative of data to be transmitted to the external control unit means; and

means associated with each subscriber device means for receiving the first control signal, for comparing the received address signal data to

the associated address signal information, and for enabling said transmitter means associated with said subscriber device means to transmit the second control signal if the received address signal data bear a predetermined relationship to the associated address signal information.

32. The cable television system of claim 31, wherein:

a plurality of subscriber device means are connected to the same drop cable; and the device polling means includes means for applying to that drop cable in a predetermined order a plurality of first control signals, each first control signal including address data indicative of a different one of the subscriber devices connected to that drop cable.

33. The cable television system of claim 32, wherein at least one of the subscriber device means is a subscriber processing unit means for allowing the subscriber to apply to the drop cable and communicate to the external control unit means second control signals indicative of the portion of the television signal which that subscriber wishes to select.

34. A cable television system for providing selected television signals to a plurality of remotely located subscriber premises via a cable network, comprising:

head end means for transmitting a television signal to a plurality of remote locations, each of which is adjacent but external to a respective subset of the subscriber premises;

external control unit means connected to the cable network at each of the remote locations

for receiving the television signal said external control unit means including a slave cable terminal to which the television signal received from the cable network is applied;

a plurality of drop cables connected to each external control unit means, each drop cable conducting a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber processing unit means connected to each drop cable at the subscriber's premises for allowing the subscriber to apply to the drop cable a first control signal indicative of the portion of the television signal which that subscriber wishes to select;

first means associated with each external control unit means for processing the first control signals applied to all the drop cables associated with that external control unit means and for causing that external control unit means to apply to each associated drop cable the portion of the television signal indicated by the first control signal received via that drop cable, the first means including common signal processing circuitry which at least partially processes the information represented by the first control signals applied to all of the drop cables associated with that external control unit means; and

slave external control unit means connected to the slave cable terminal of one of said external control unit means for supplying selected portions of the television signal to additional subscriber processing unit means associated with said slave external control unit means.

35. A cable television system for providing selected television signals to a plurality of remotely located subscriber premises via a cable network, comprising:

head end means for transmitting a television signal to a plurality of remote locations, each of which is adjacent but external to a respective subset of the subscriber premises;

external control unit means at each of the remote locations for receiving the television signal from the cable network;

a plurality of drop cables connected to each external control unit means, each drop cable conducting a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber processing unit means connected to each drop cable at the subscriber's premises for allowing the subscriber to apply to the drop cable a first control signal indicative of a first portion of the television signal which that subscriber wishes to select;

slave subscriber processor unit means connected to the drop cable at at least one subscriber's premises for allowing the subscriber to apply to the drop cable a second control signal indicative of a second portion of the television signal which that subscriber wishes to select; and

means associated with each external control unit means for processing the first and second control signals applied to the drop cables associated with that external control unit means and for causing that external control unit means to apply to each associated drop cable in a first predetermined channel the portion of the television signal indicated by the first control signals received via

that drop cable, and to apply to the drop cable associated with the slave subscriber processing unit means in a second predetermined channel the portion of the television signal indicated by the second control signal received via that drop cable, the first means including common signal processing circuitry which at least partially processes the information represented by the first and second control signals applied to all of the drop cables associated with that external control unit means.

36. A cable television system for providing selected television signals to a plurality of remotely located subscriber premises, comprising:

head end means for transmitting a television signal;

a cable network having a plurality of cables connected in parallel, each cable conducting a different part of the television signal from the head end means to a plurality of remote locations, each of which is adjacent but external to a respective subset of the subscriber premises;

external control unit means at each of the remote locations connected to each of the plurality of cables for receiving the television signal from the cable network;

a plurality of subscriber unit means associated with each external control unit means, each subscriber unit means connected to a drop cable for providing a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber processing unit means connected to each drop cable at the subscriber premises for allowing the subscriber to apply to the drop

cable a control signal indicative of the portion of the television signal which that subscriber wishes to select;

cable selecting means associated with each subscriber unit means for selectively connecting each subscriber unit means to one of the plurality of cables of the cable network;

first means associated with each external control unit means for processing the first control signals applied to all the drop cables associated with that external control unit means and for causing each subscriber unit means to apply to each associated drop cable the portion of the television signal indicated by the first control signal received via that drop cable, the processing means including common signal processing circuitry which at least partially processes the information represented by the first control signals applied to all of the drop cables associated with that external control unit means; and

second means responsive to the first means for causing each cable selecting means to connect its associated subscriber unit means to the cable conducting the part of the television signal which includes the portion of the television signal indicated by the first control signal received via the associated drop cable.

37. A cable television system for providing selected television signals to a plurality of remotely located subscriber premises via a cable network, the cable network including a frequency band for reverse communication to the head end, comprising:

head end means for transmitting a television signal to a plurality of remote locations, each of which is adjacent but external to a respective subset of the subscriber premises;

external control unit means at each of the remote locations for receiving the television signal from the cable network;

a plurality of drop cables connected to each external control unit means, each drop cable conducting a selected portion of the television signal from the external control unit means to a respective one of the subscriber premises associated with that external control unit means;

subscriber processing unit means connected to each drop cable at the subscriber premises for allowing the subscriber to apply to the drop cable a first control signal including data indicative of the portion of the television signal which that subscriber wishes to select and subscriber data for transmission to the head end;

first means associated with each external control unit means for processing the first control signals applied to all the drop cables associated with that external control unit means and for causing that external control unit means to apply to each associated drop cable the portion of the television signal indicated by the first control signal received via that drop cable, and to transmit to the head end signals including the subscriber data indicated by the first control signal, said first means including common signal processing circuitry which at least partially processes the information represented by the first control signals applied to all of the drop cables associated with that external control unit means;

second means connected to each drop cable at the subscriber premises for allowing the subscriber to apply to the drop cable a second control signal including data to be transmitted from the subscriber premises to the head end; and

third means associated with each external control unit means and connected to each drop cable and to the cable network for allowing the second control signal to pass through the external control unit means and directly to the head end in a frequency band comprising a portion of the total frequency band available on the cable network for reverse communication so that ingress onto the cable network from the drop cables of signals interfering with the transmitted subscriber data signals is minimized.

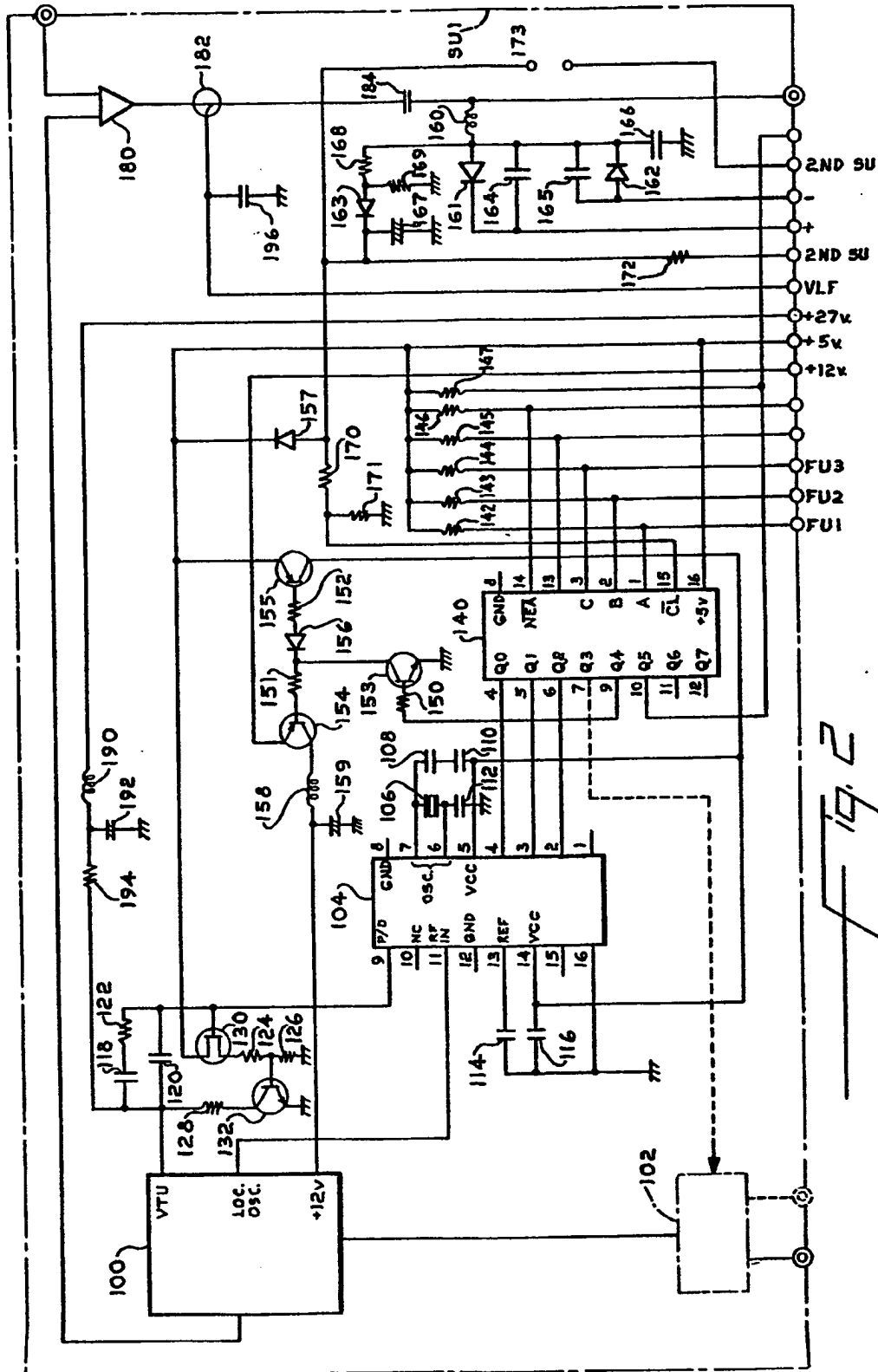
38. The apparatus of claim 37, wherein said third means comprises a bandpass filter.



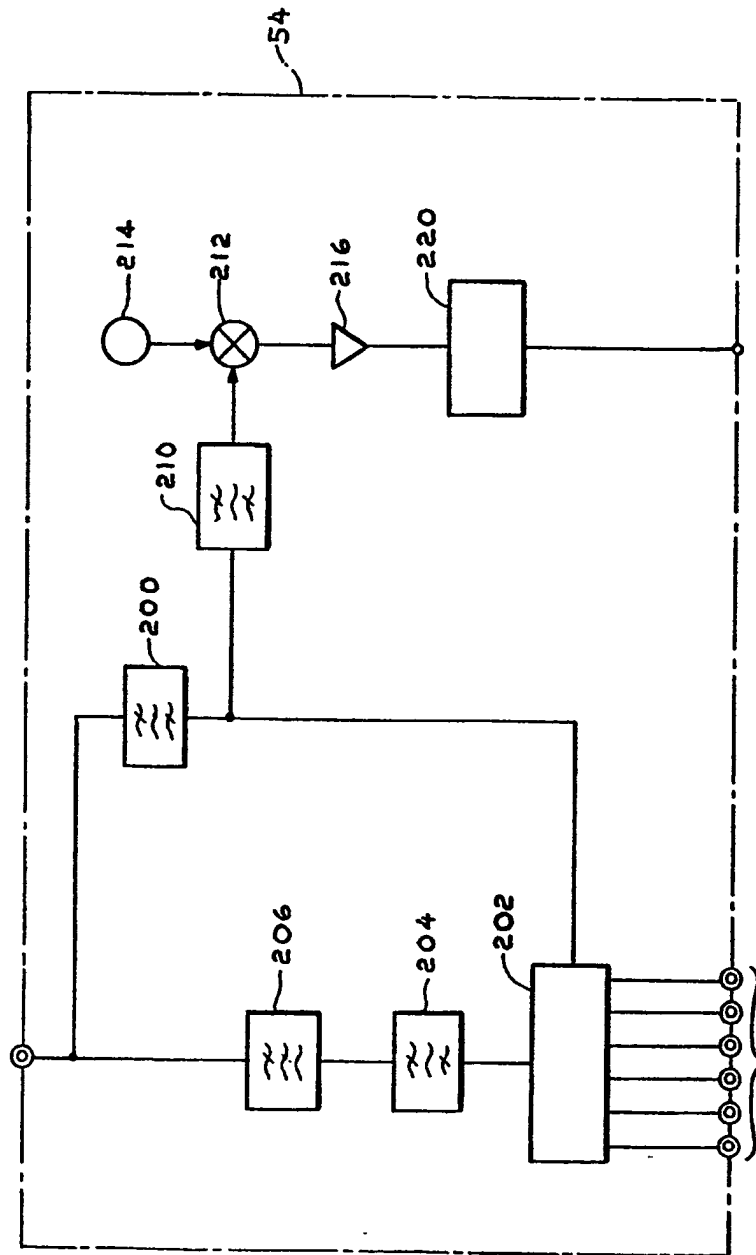


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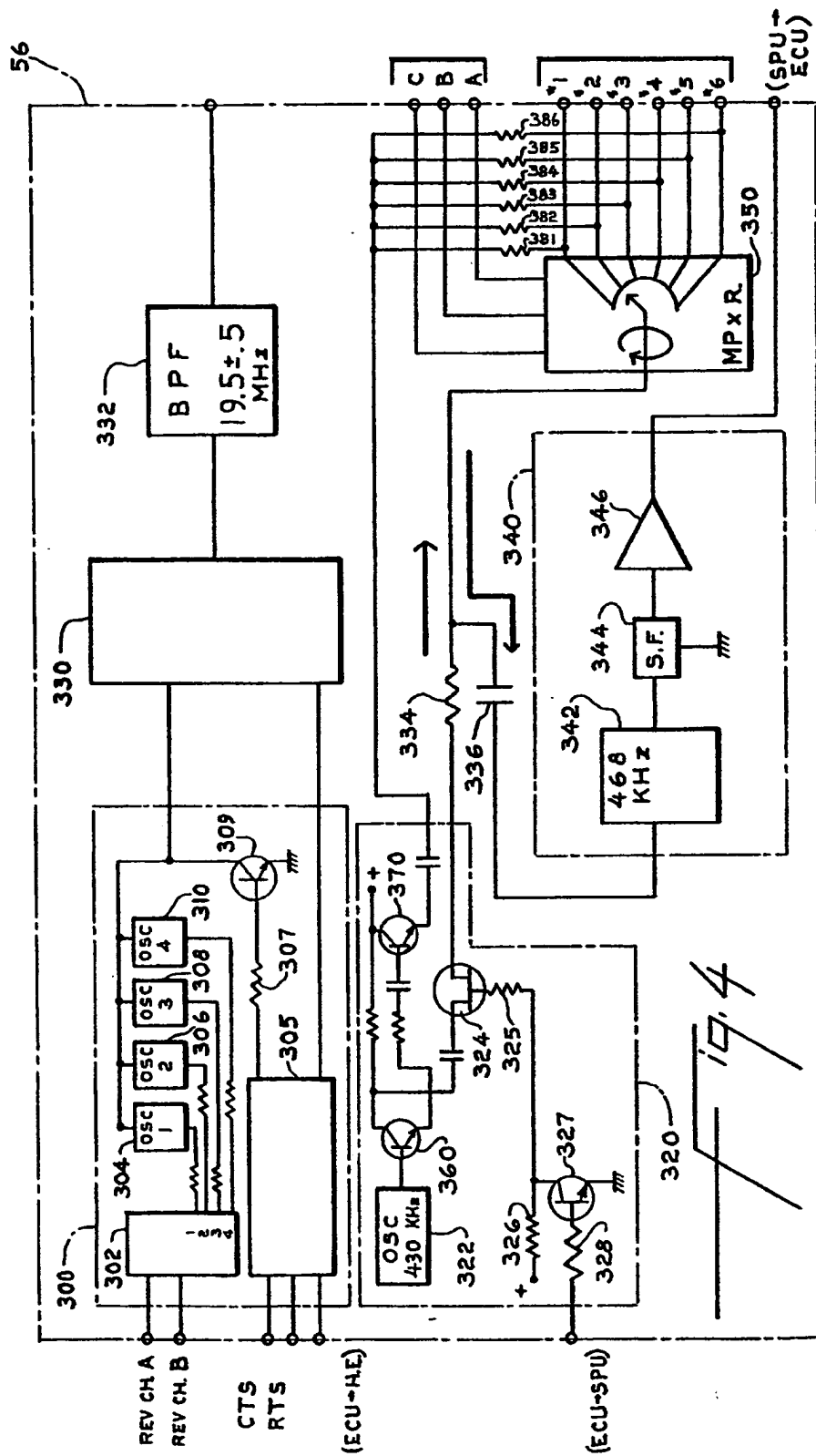
19.2



19.3

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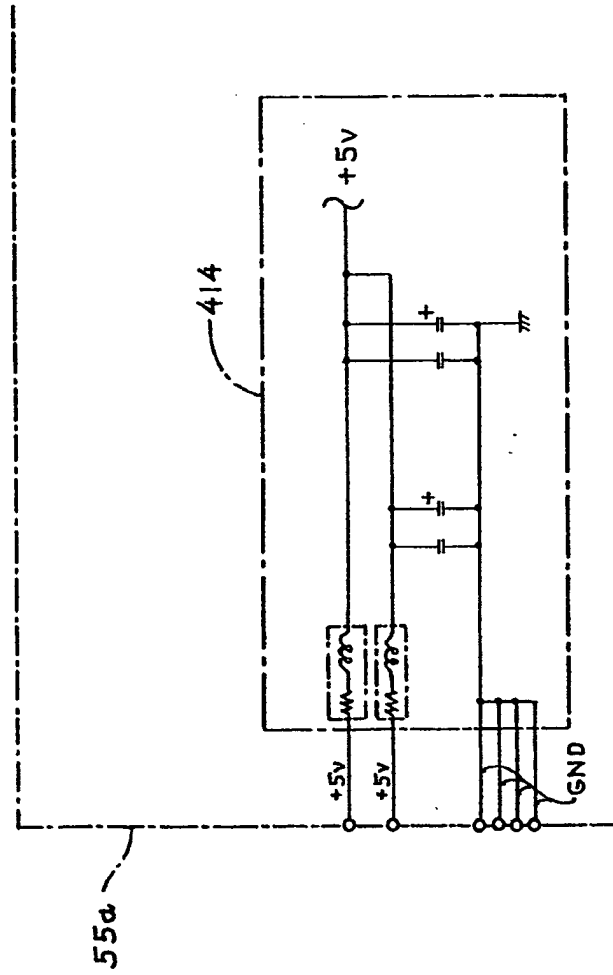
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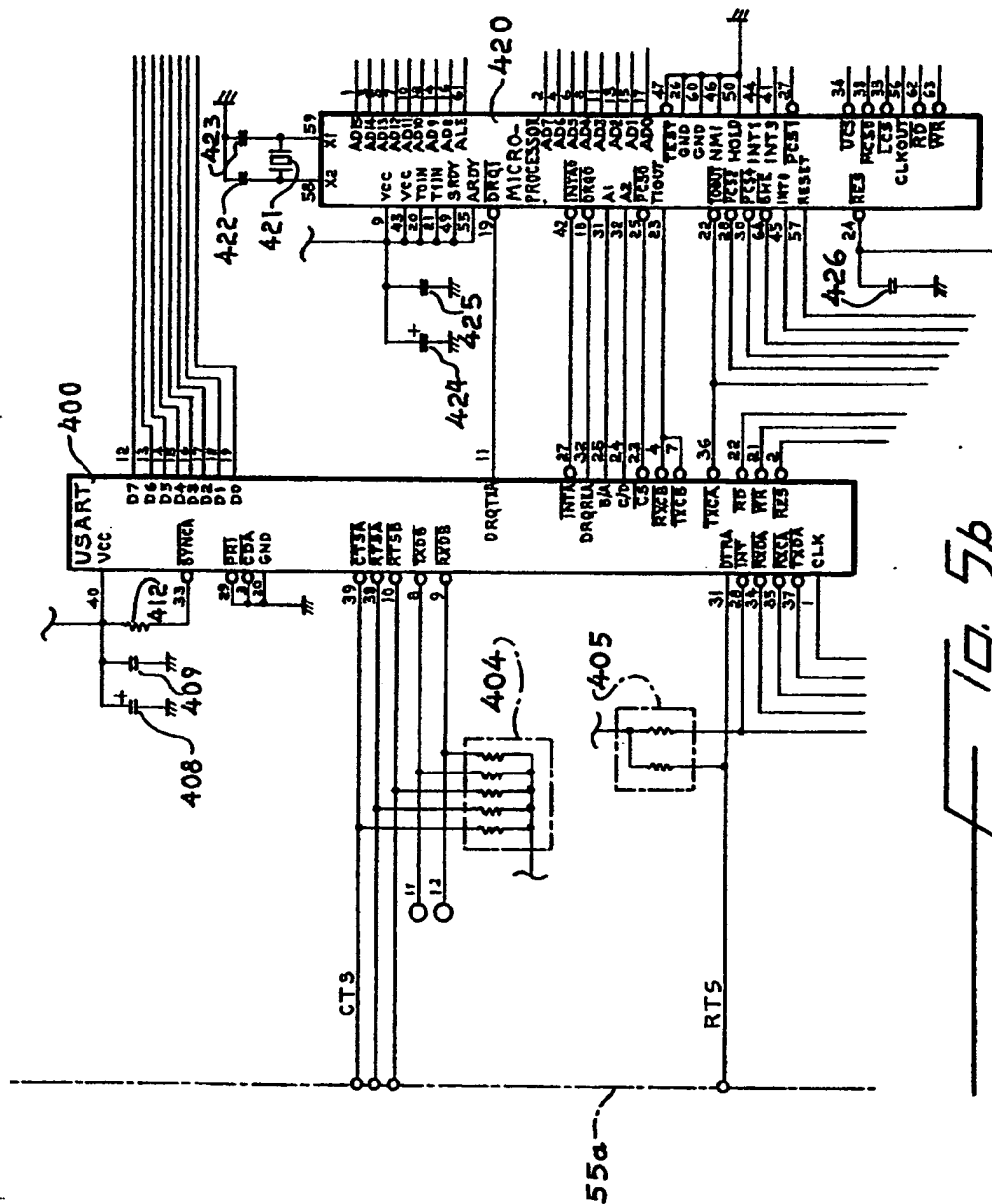
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19.5a



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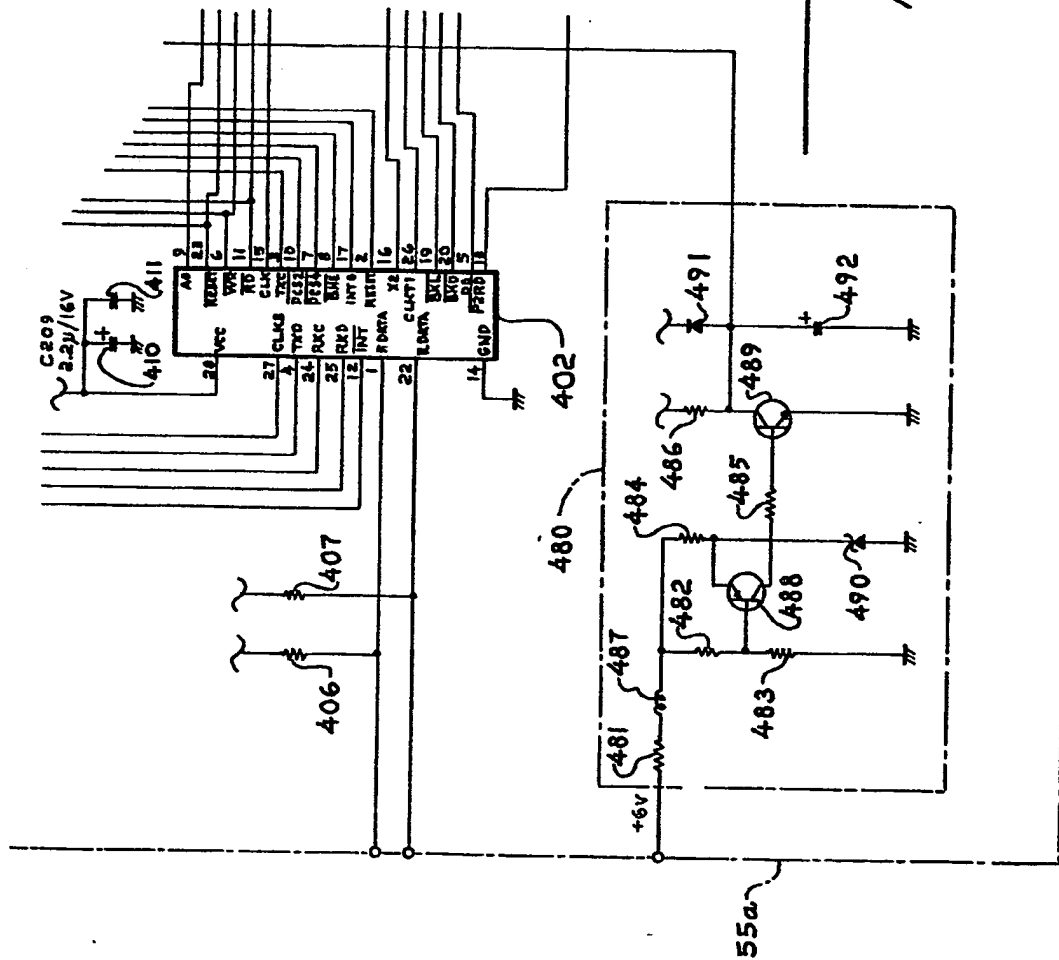


19.5b

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19.50

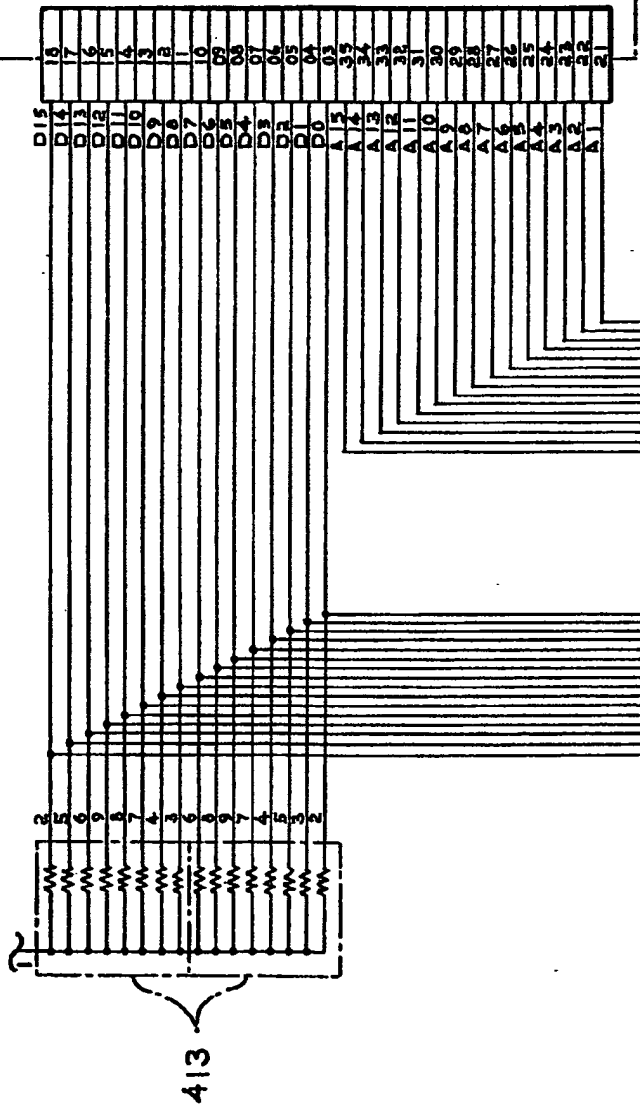


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Fig. 5d

55a

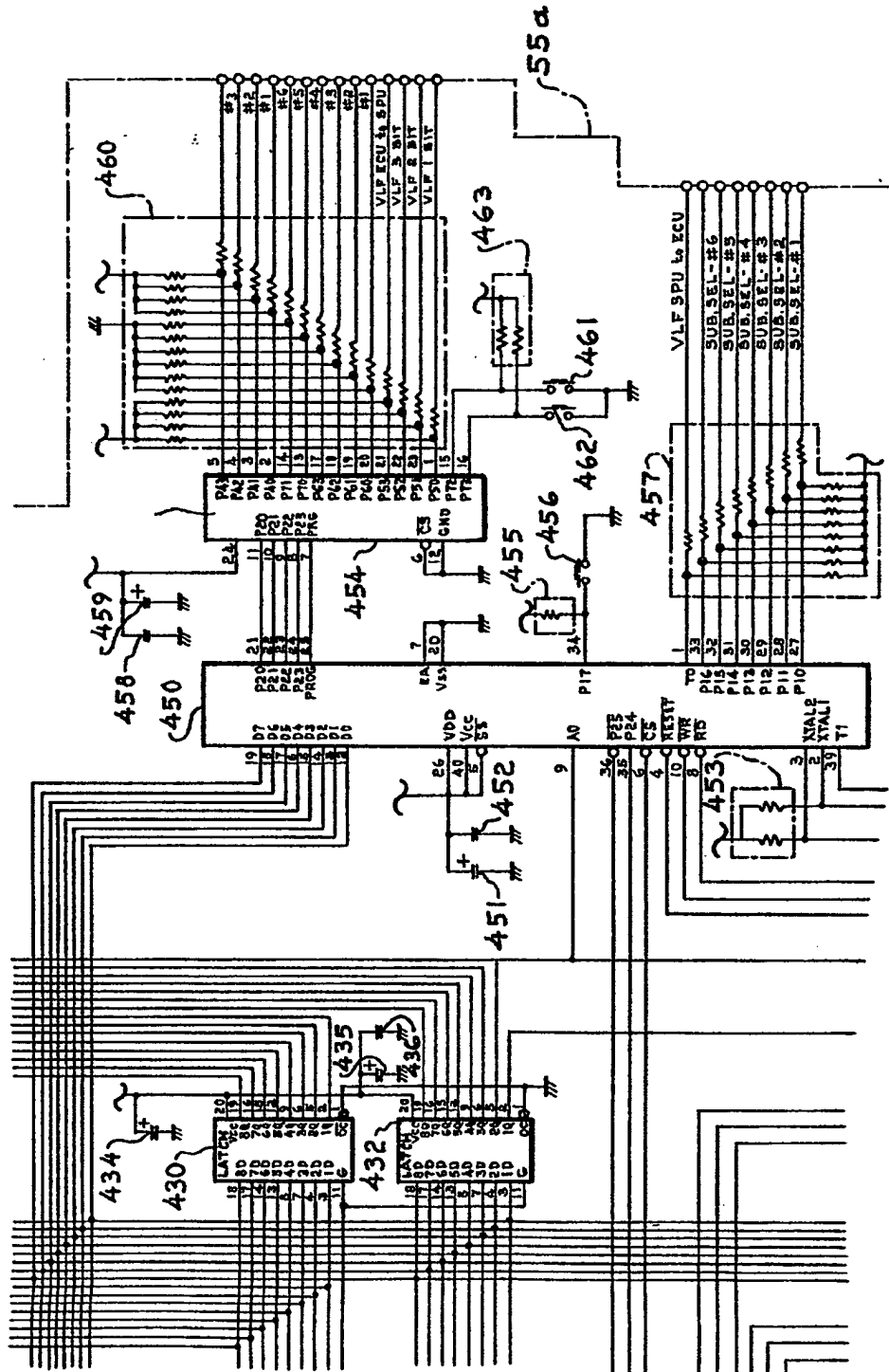


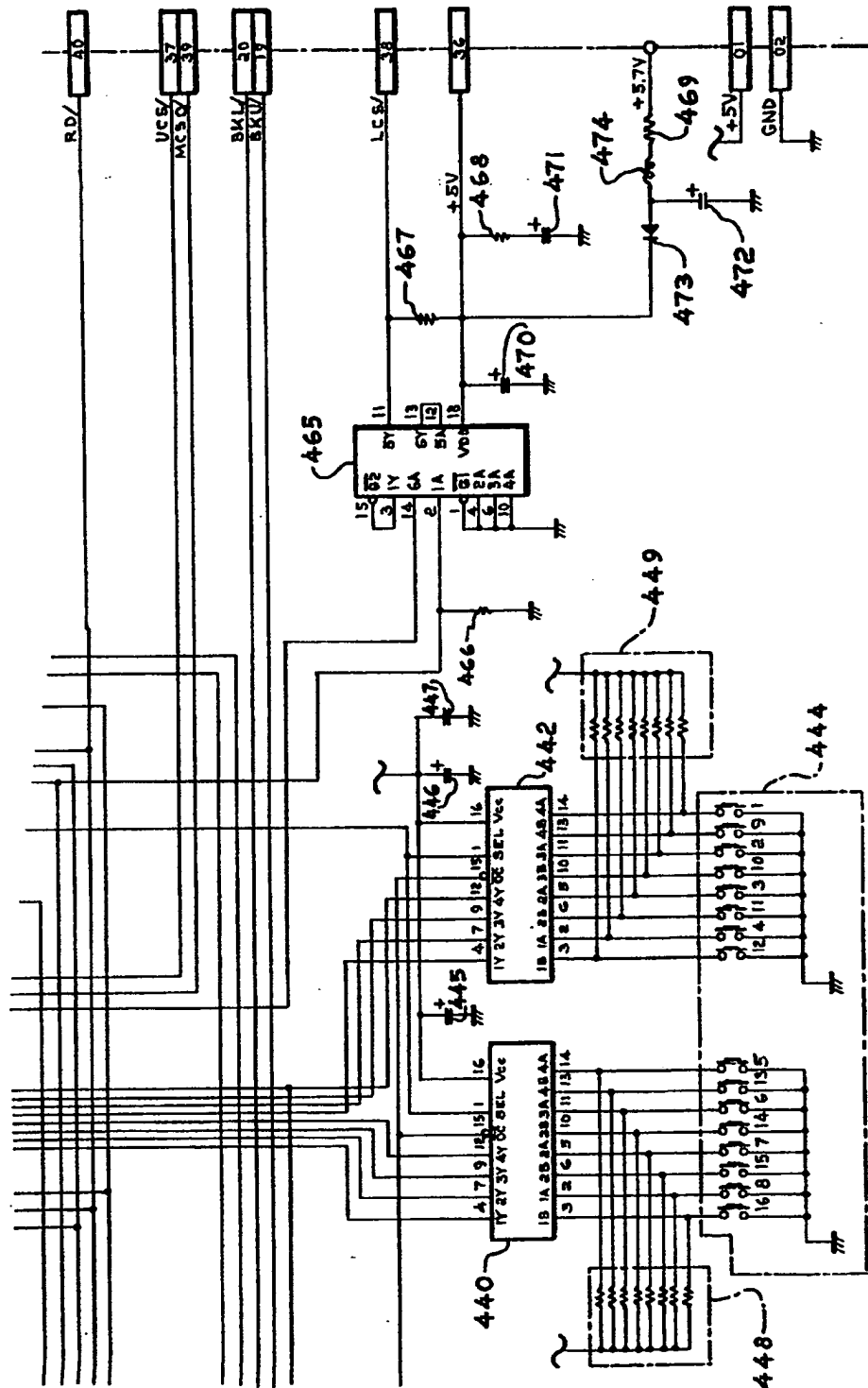


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195e

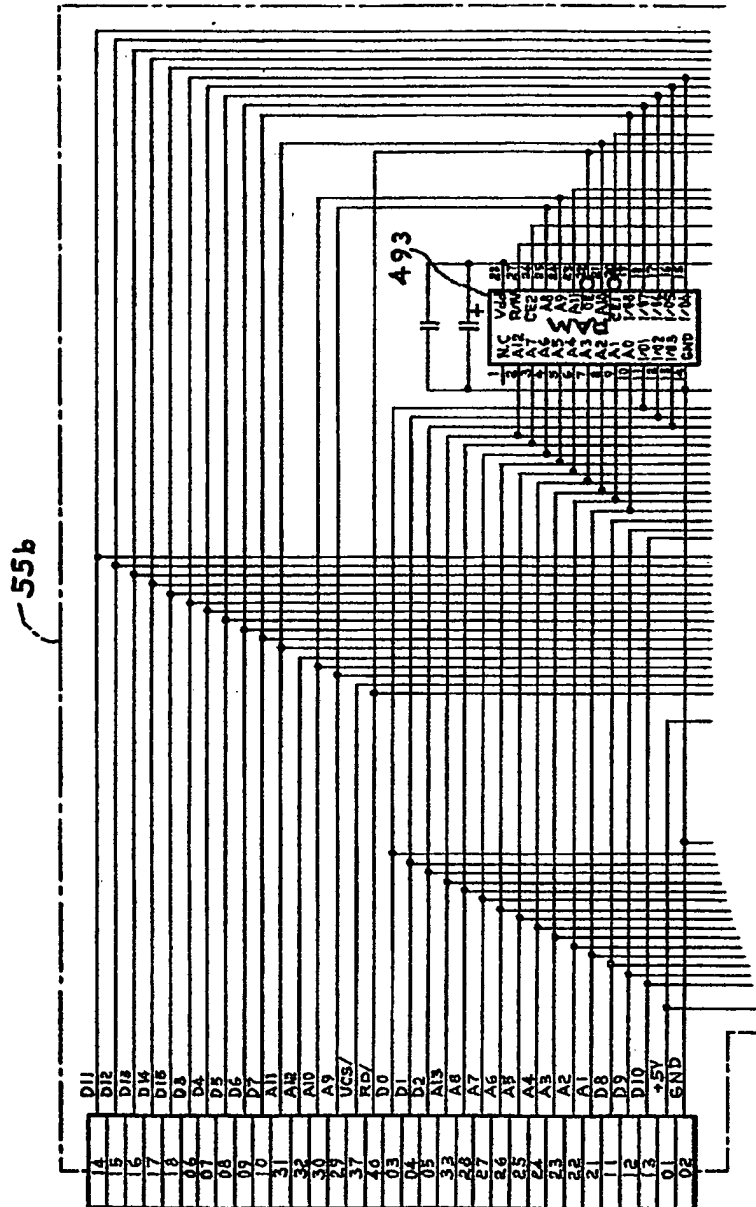




5a F 19.5f

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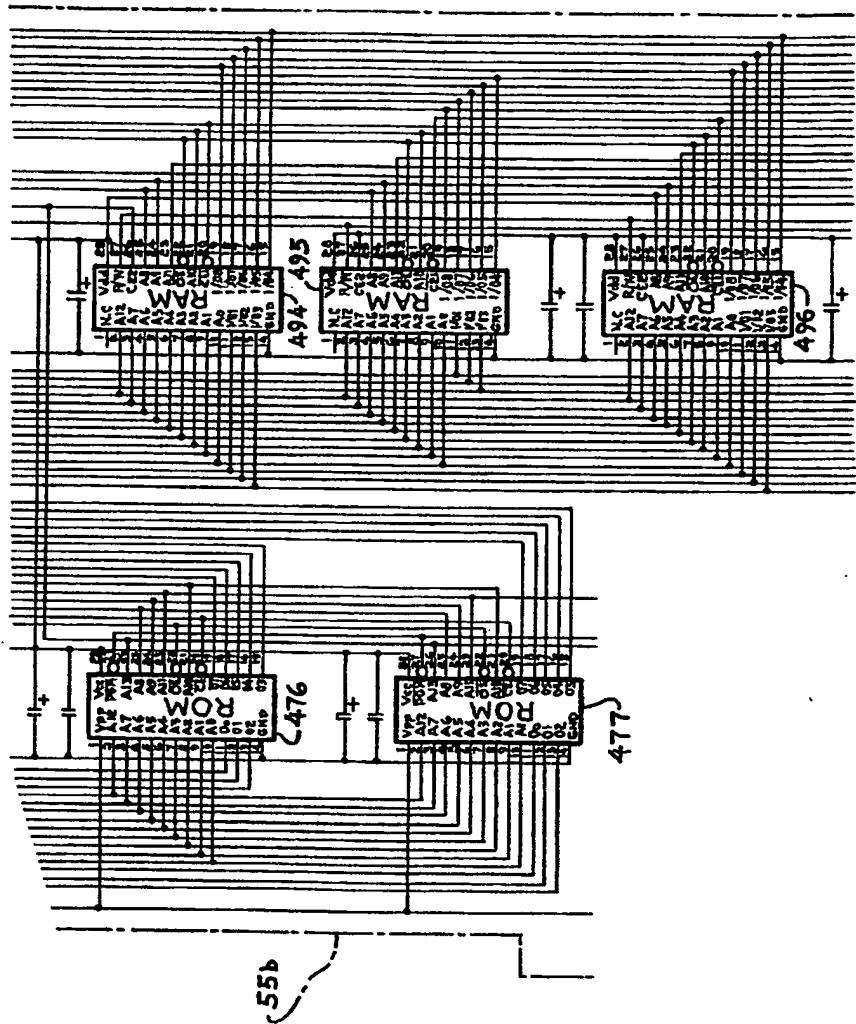


65 19.59

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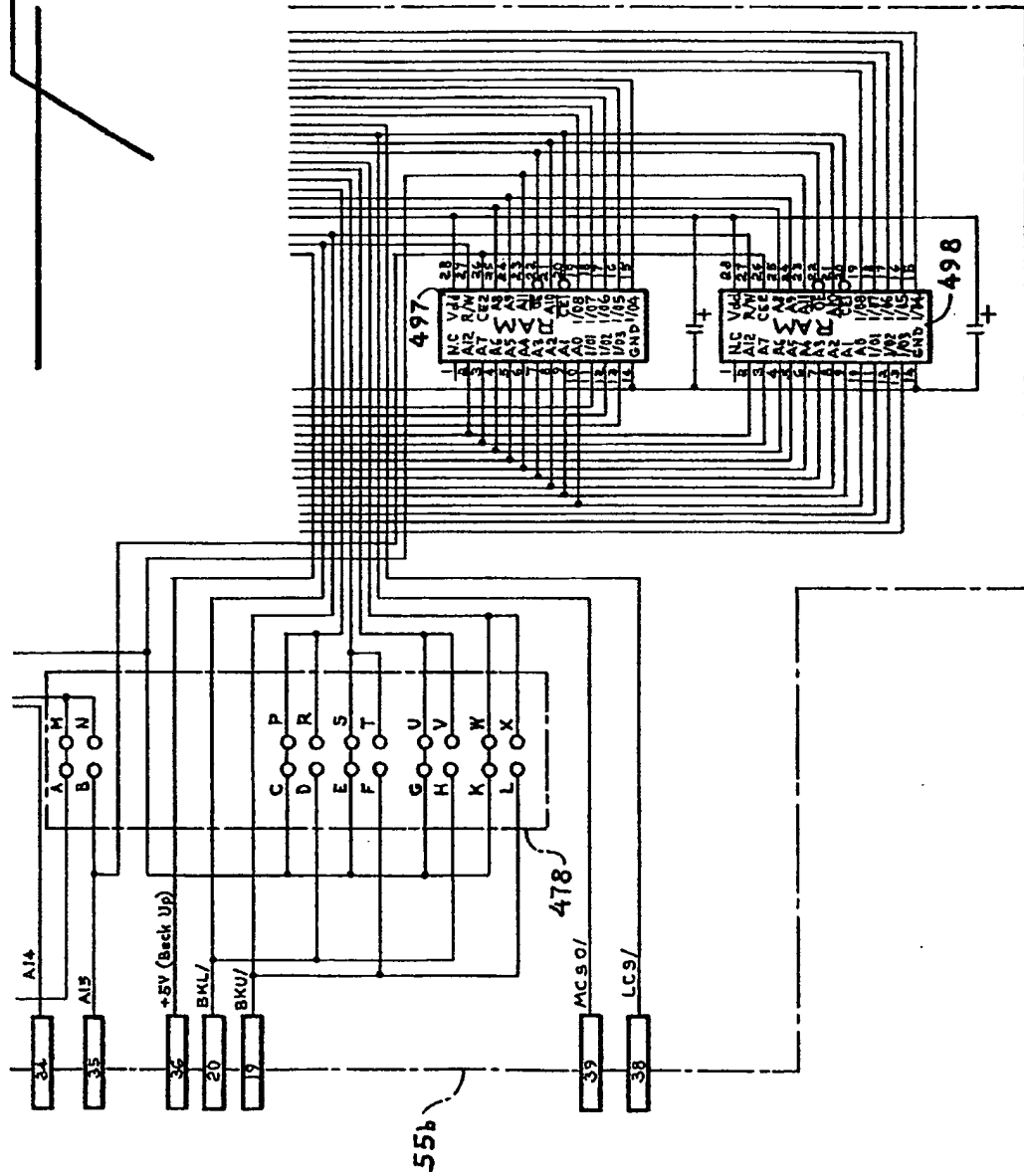
45  
19.5h



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19.51



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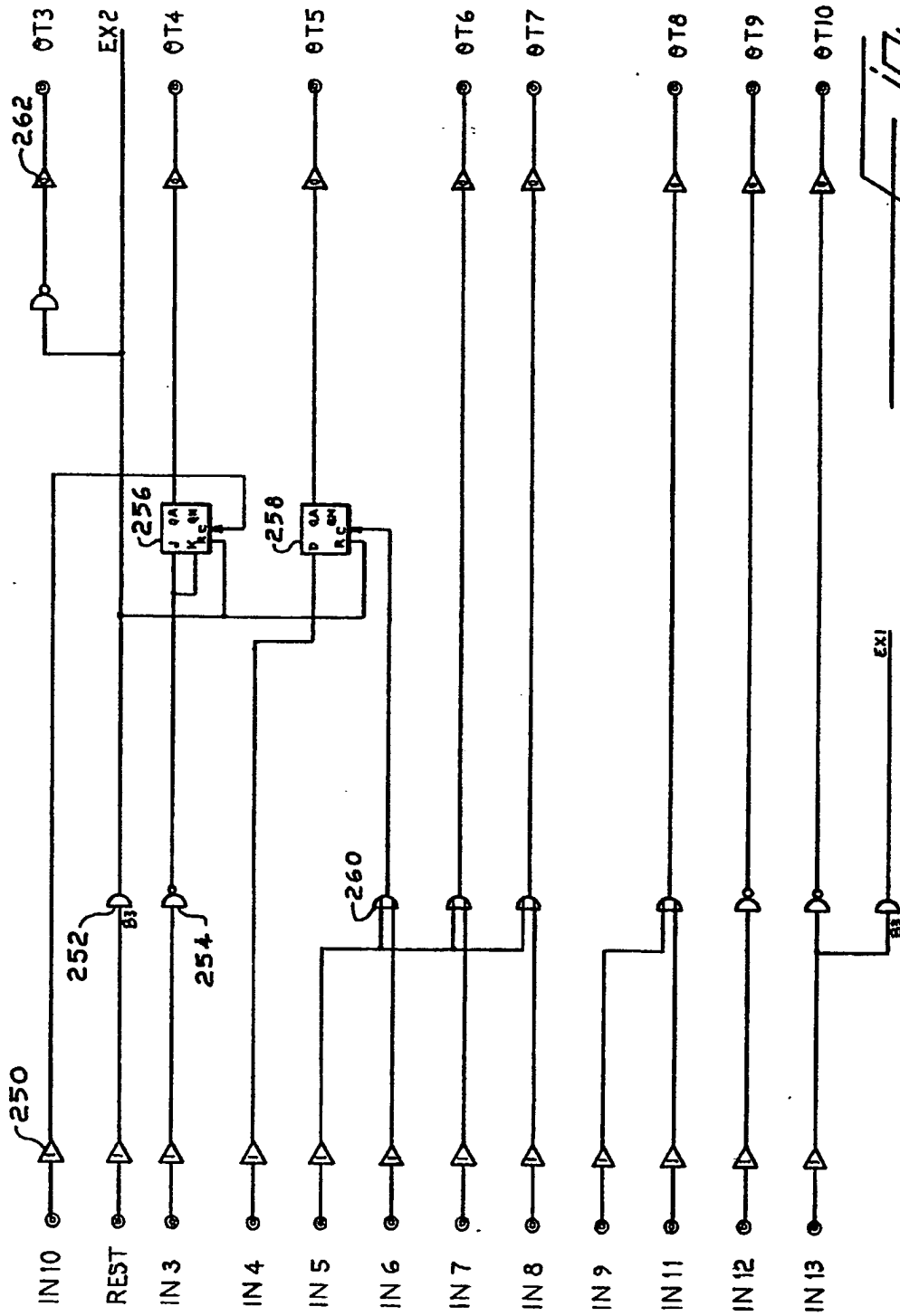
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55		
55a		55b
f 19.5a	f 19.5d	f 19.5g
f 19.5b	f 19.5e	f 19.5h
f 19.5c	f 19.5f	f 19.5i

f 19.5j

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19.5K

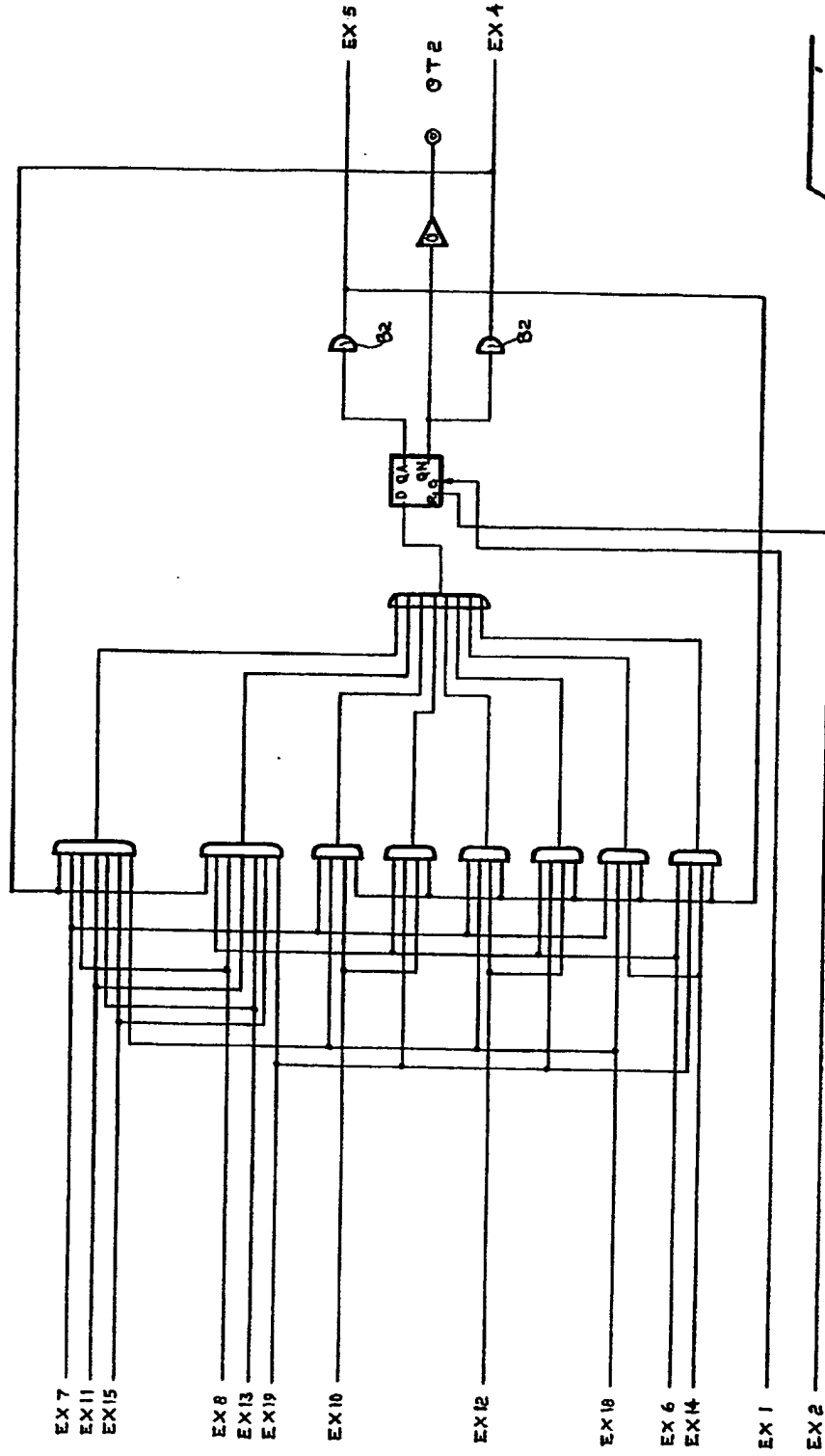




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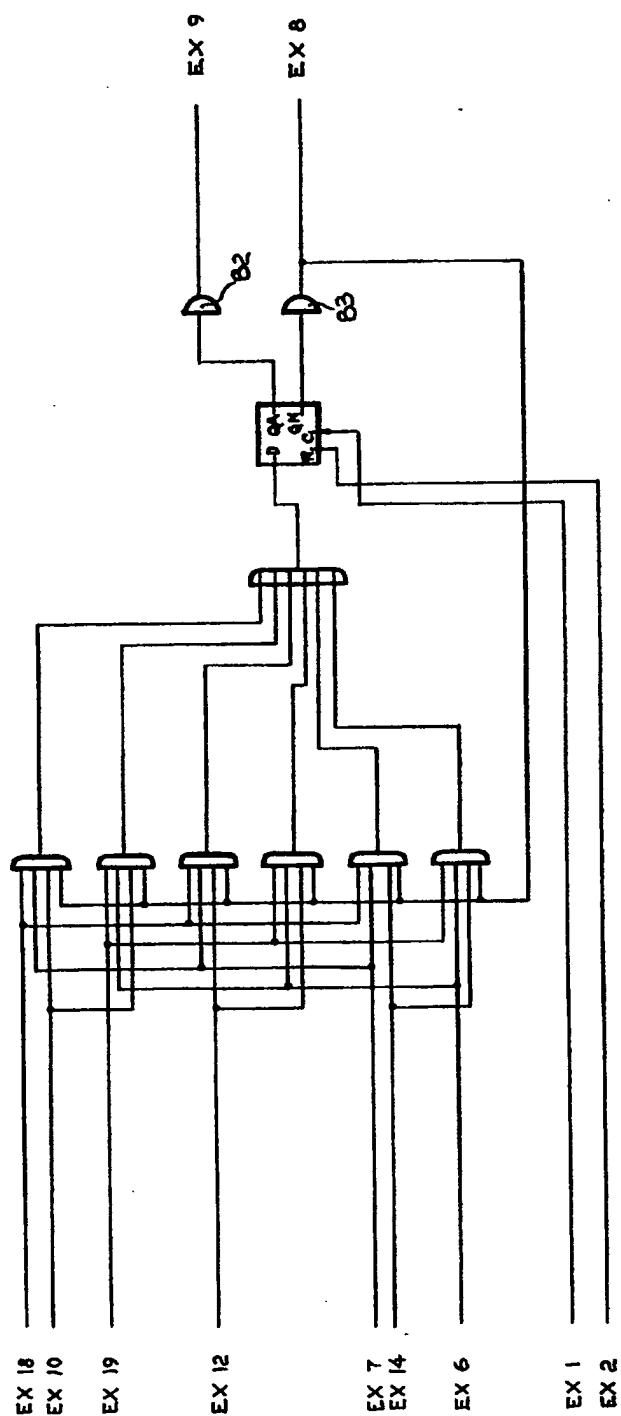
19.5m



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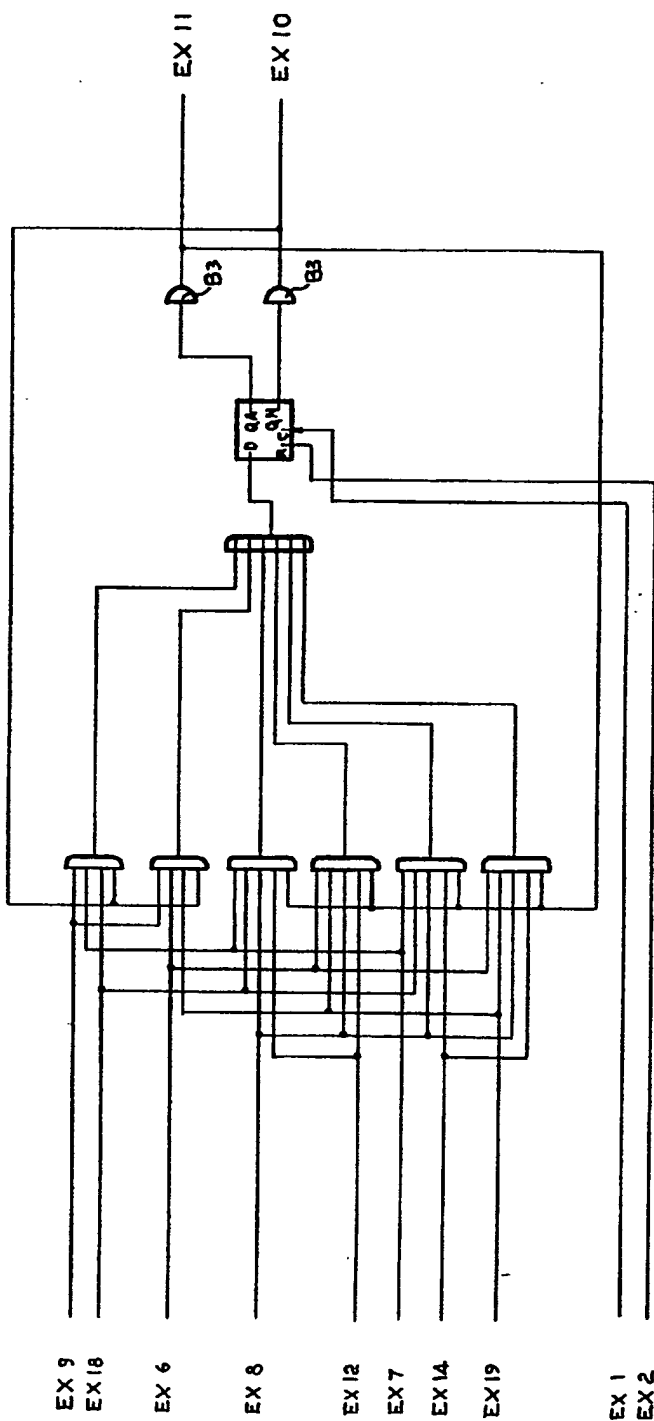
F 19.5n



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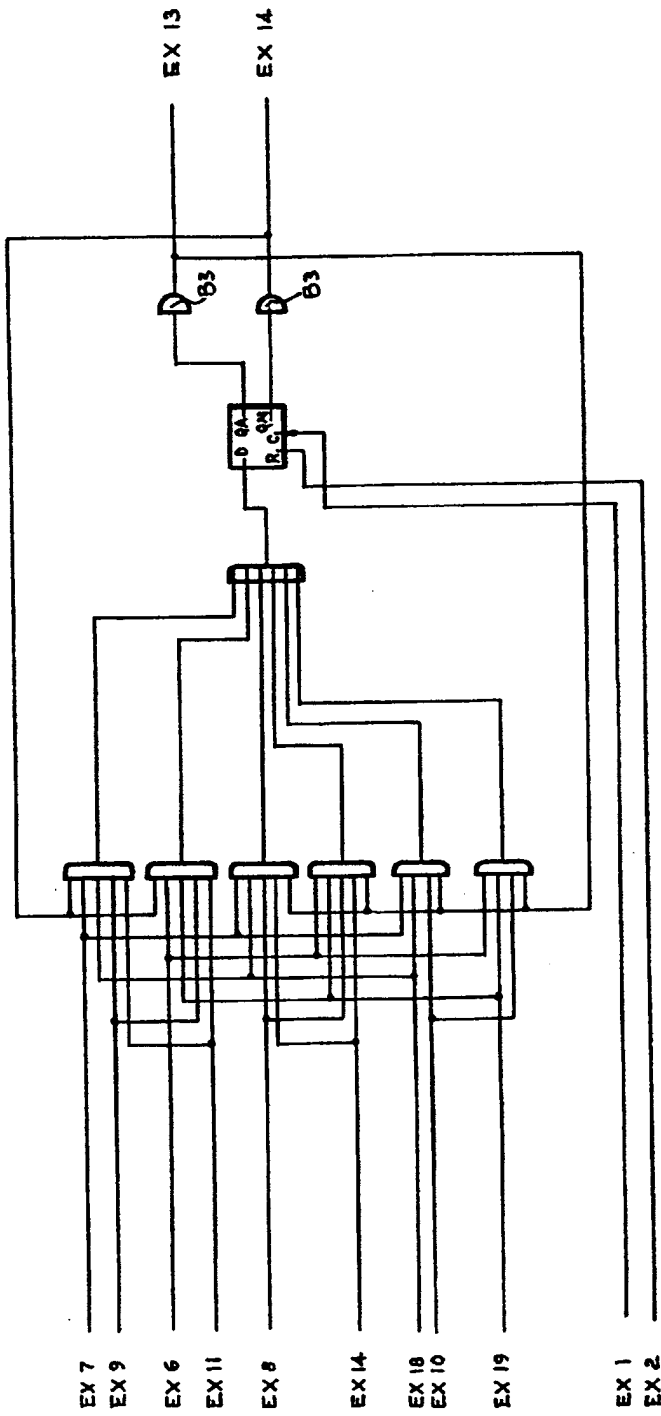
19.50



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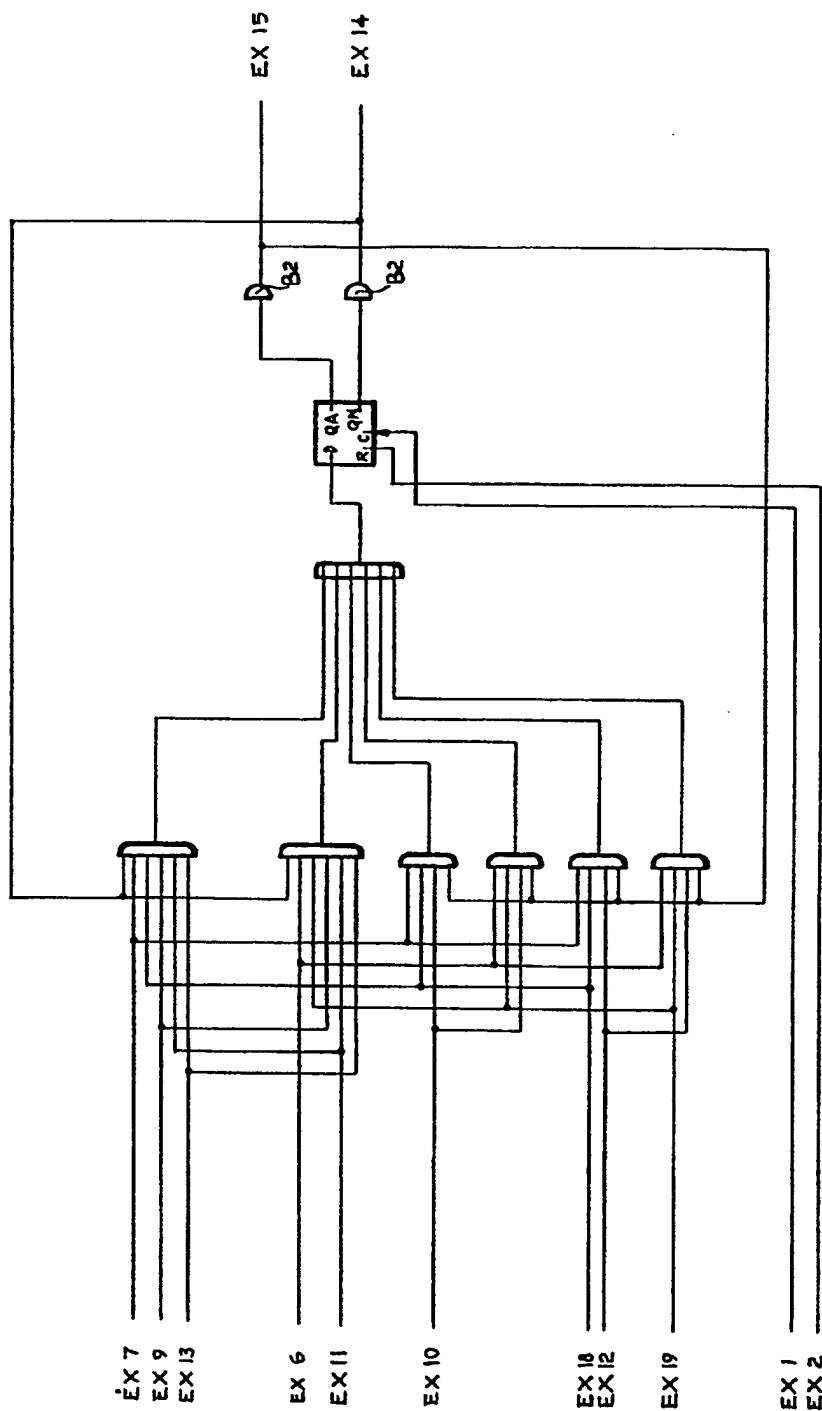
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19. Sp



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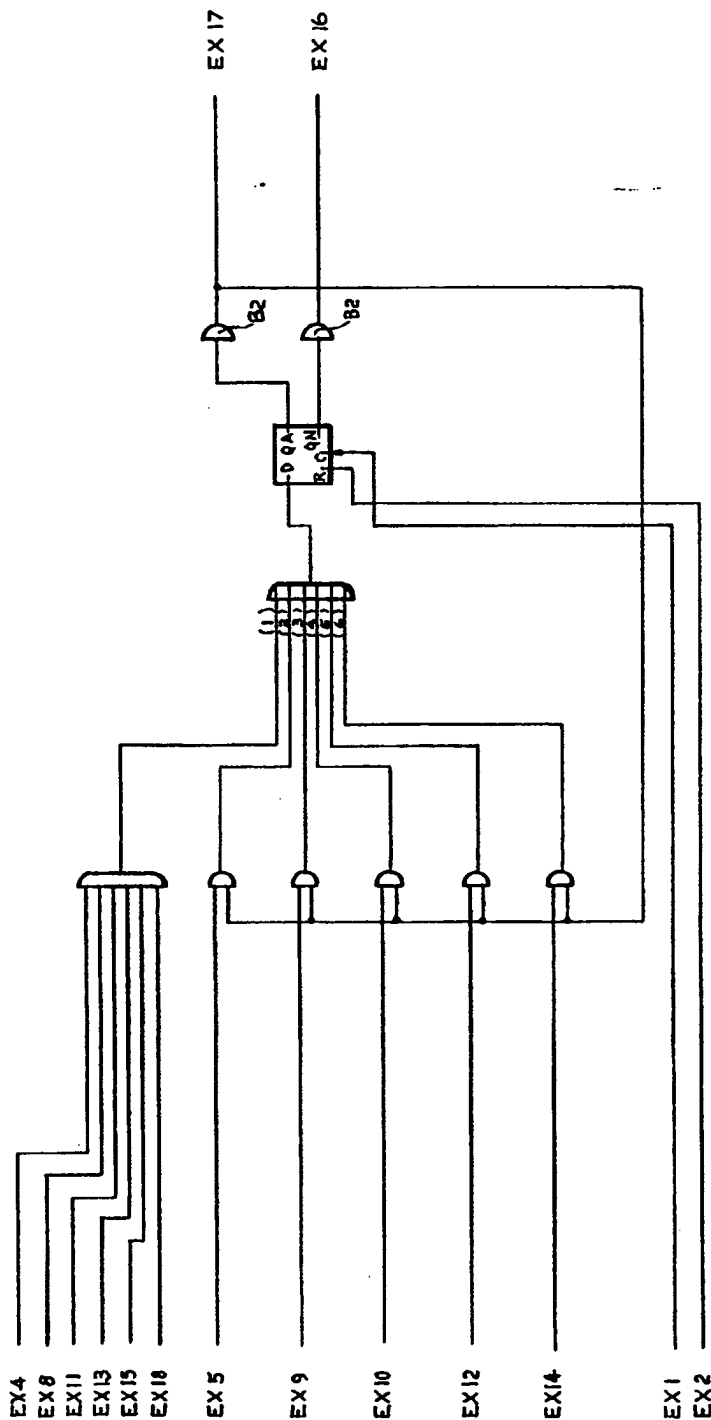
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19.59

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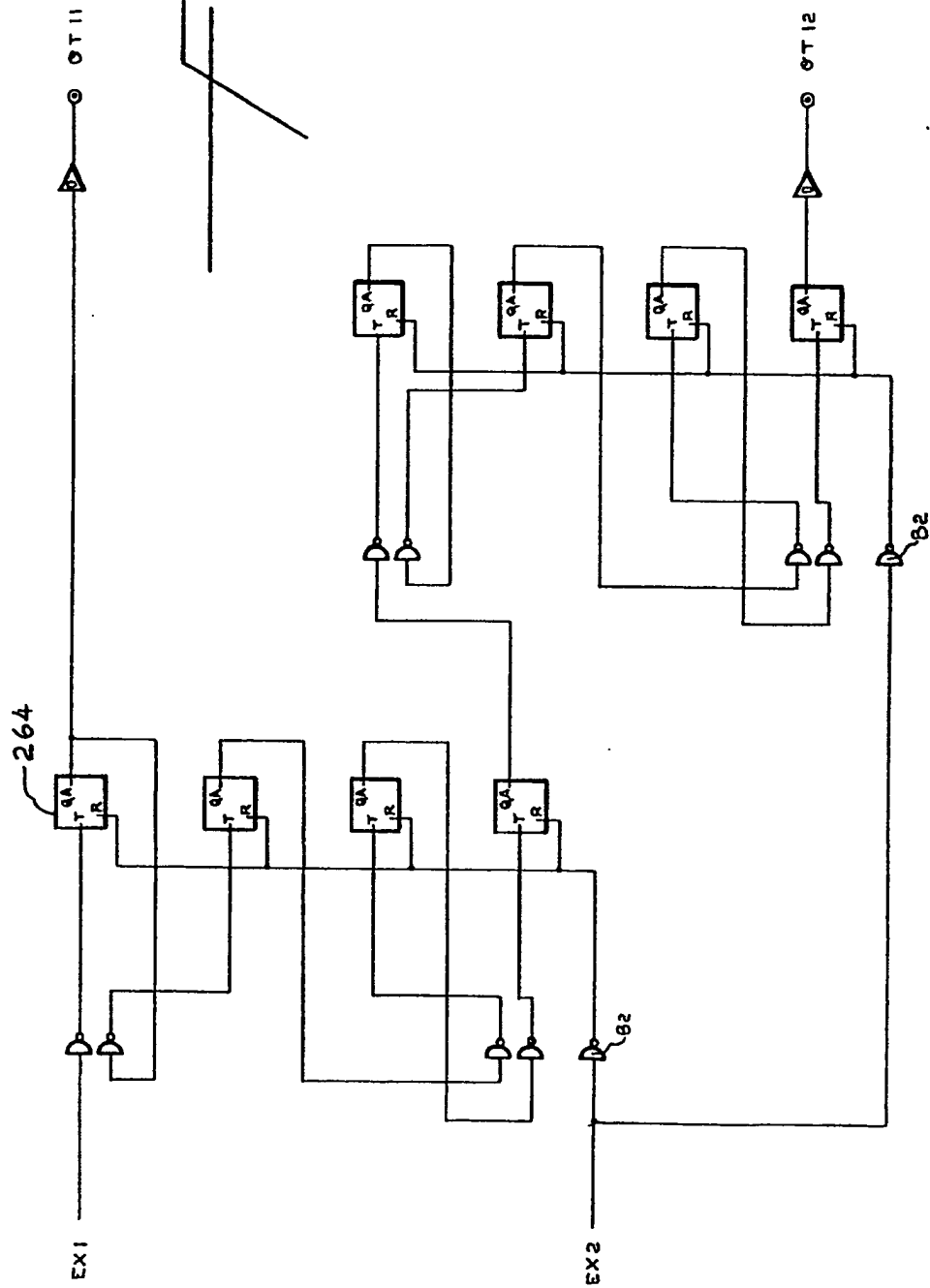


19.5r

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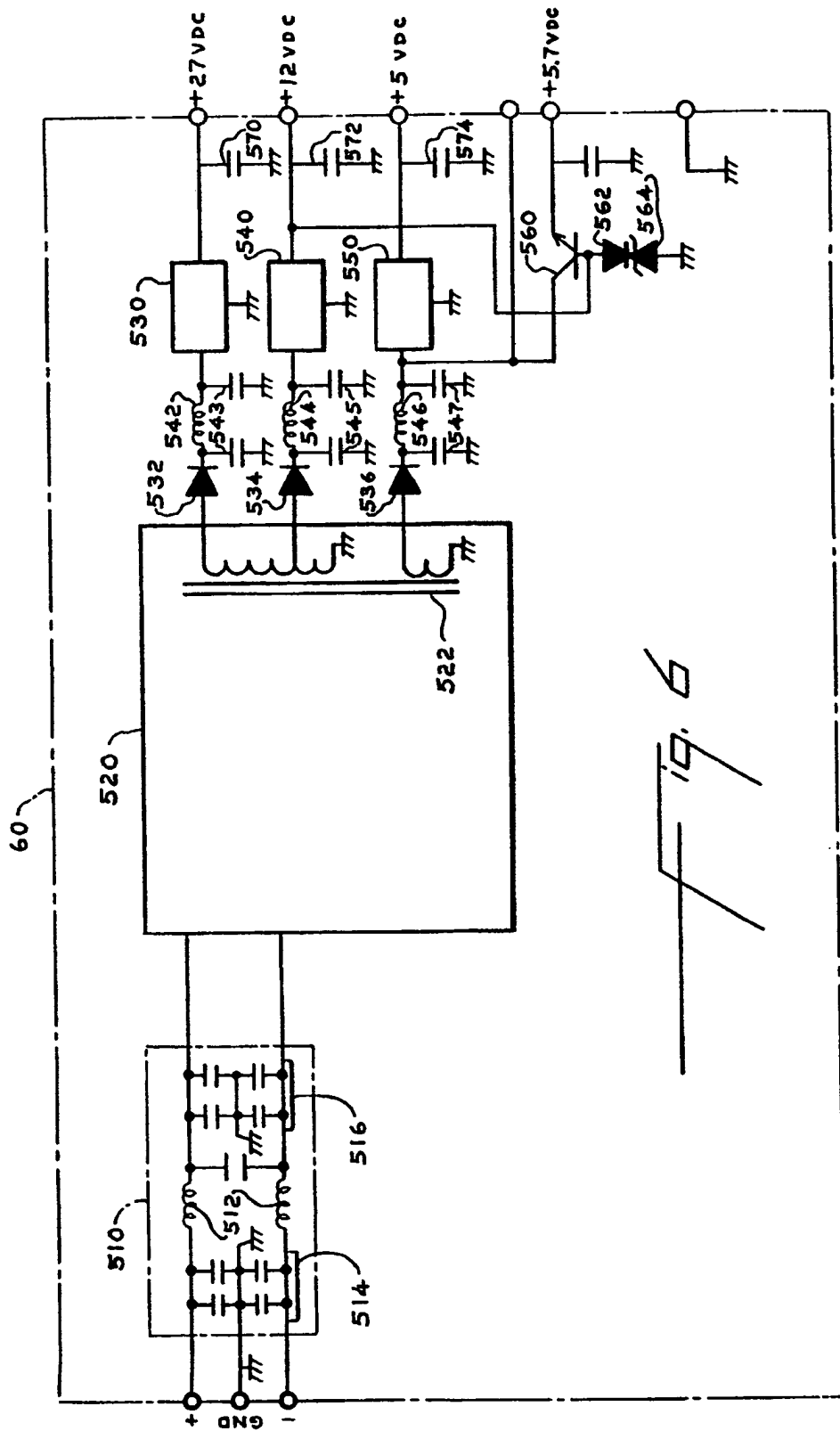
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19.55



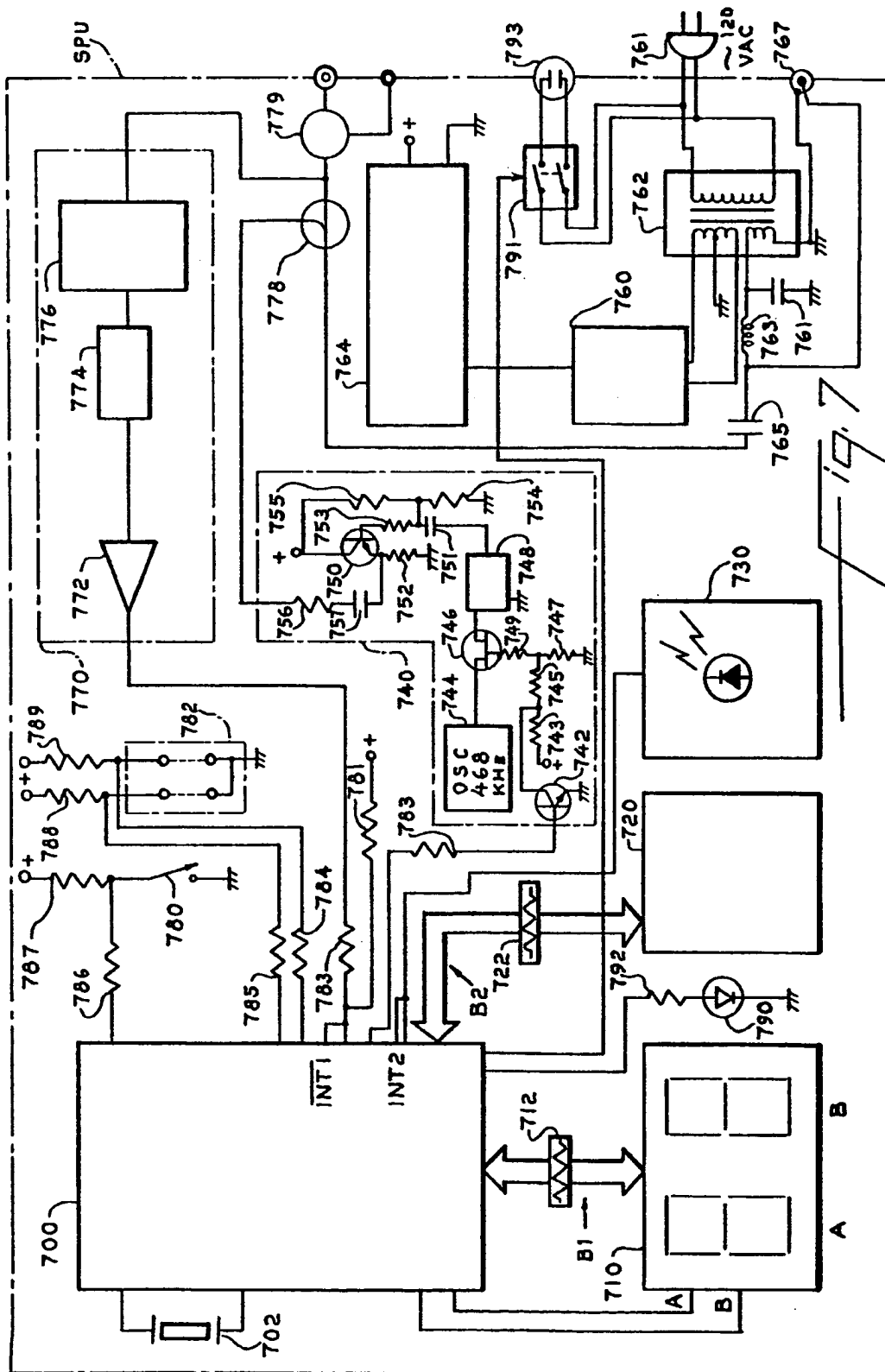
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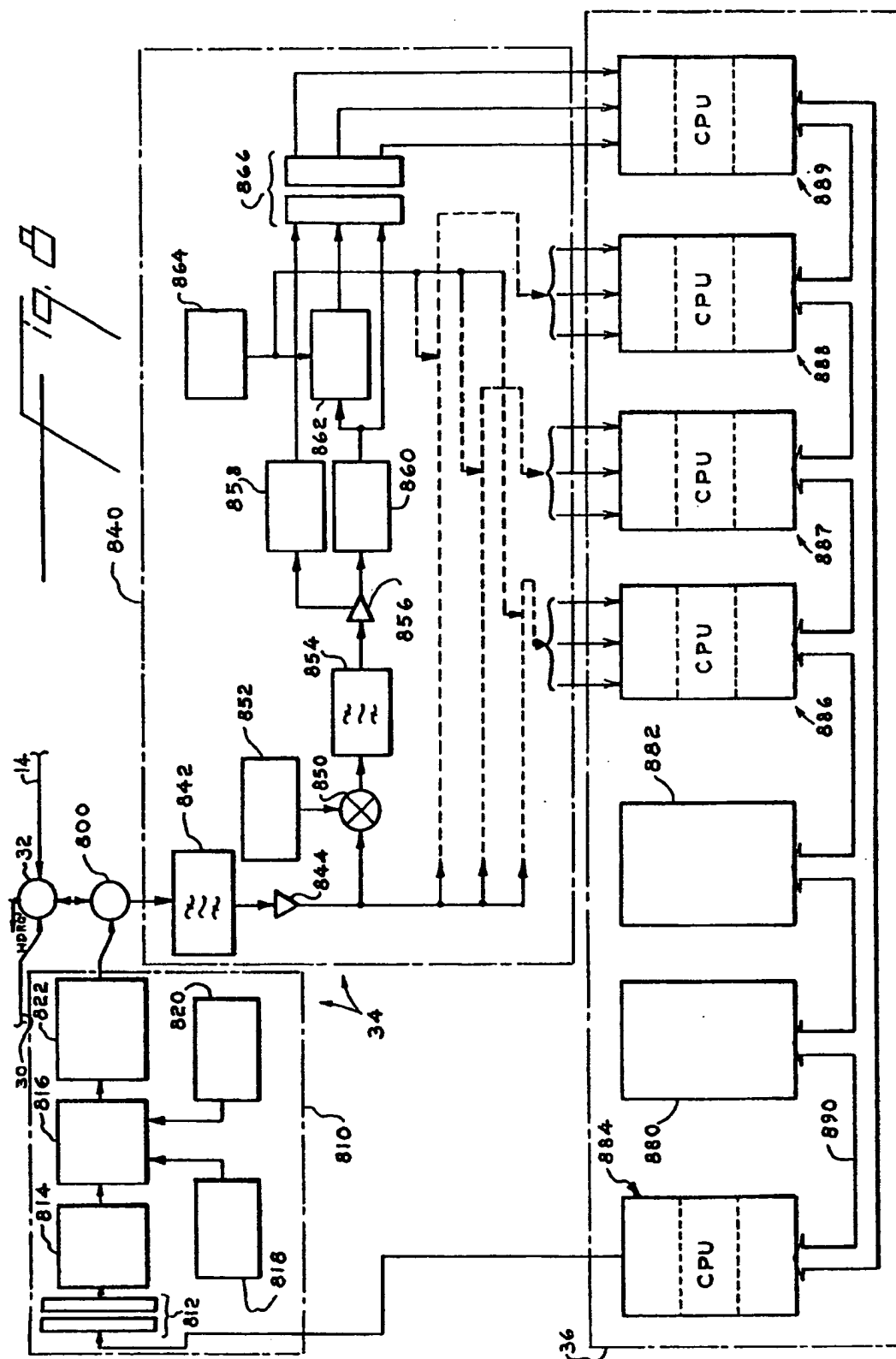


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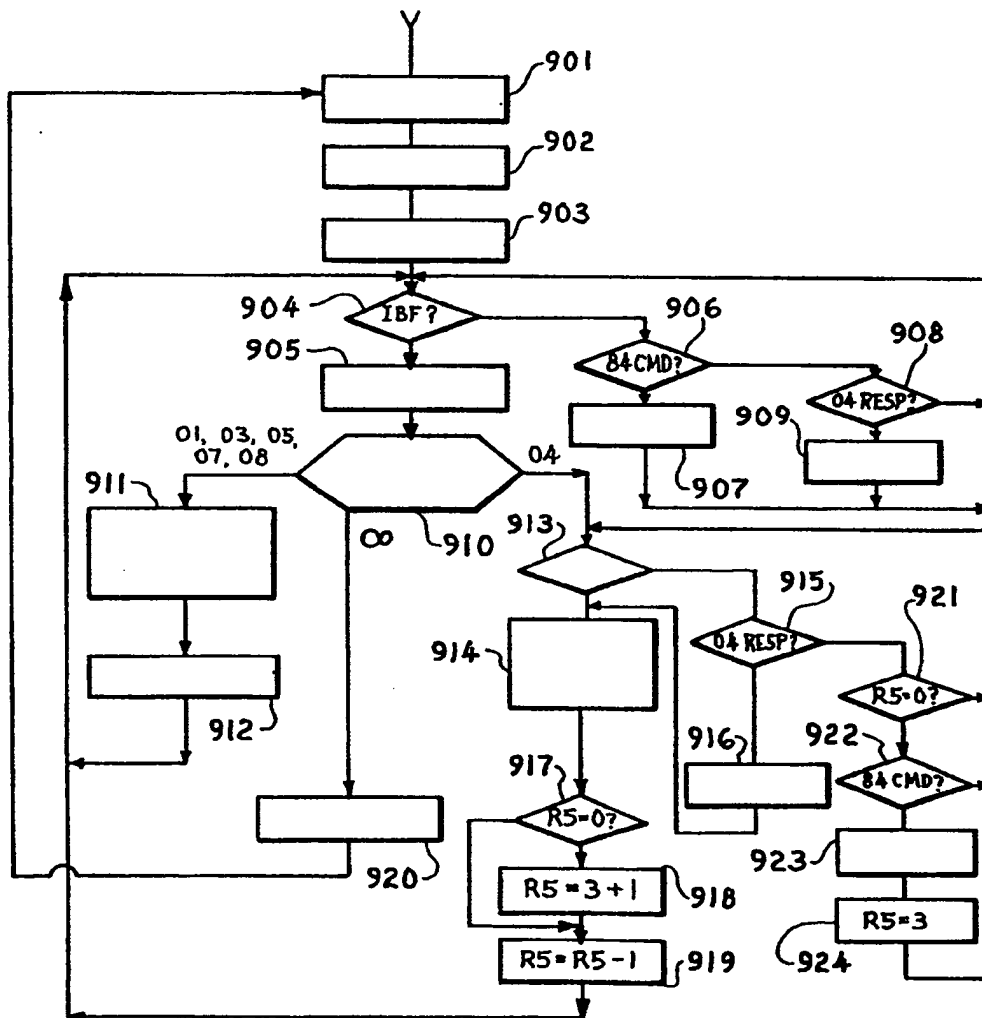
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Fig. 9A





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	ADH	ADL	N	CMD		CRH	CRL	
--	-----	-----	---	-----	--	-----	-----	--

19.10a

	00	00	MH	ML	RH	RL	N	CMD		CRH	CRL	
--	----	----	----	----	----	----	---	-----	--	-----	-----	--

19.10b

	ADH	ADL	N	CMD		CRH	CRL	
--	-----	-----	---	-----	--	-----	-----	--

19.11

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	ADH	ADL	N	CMD F <sub>C</sub>	NN	MADL	MADH		CRH	CRL
--	-----	-----	---	-----------------------	----	------	------	--	-----	-----

19.12

	ADH	ADL	N	CMD F <sub>B</sub> -F <sub>B</sub>	NN	MADL	MADH	CRH	CRL
--	-----	-----	---	---------------------------------------	----	------	------	-----	-----

19.13a

	ADH	ADL	N	CMD F <sub>B</sub> -F <sub>B</sub>	NN			CRH	CRL
--	-----	-----	---	---------------------------------------	----	--	--	-----	-----

19.13b

	ADH	ADL	N	CMD F <sub>0</sub> -F <sub>3</sub>	NN			CRH	CRL
--	-----	-----	---	---------------------------------------	----	--	--	-----	-----

19.14

	ADH	ADL	N	CMD F <sub>4</sub>	NN	SU	LC	CRH	CRL
--	-----	-----	---	-----------------------	----	----	----	-----	-----

19.15

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	ADH	ADL	N	CMD <sub>80</sub>	NN	SU	CRH	CRL	
--	-----	-----	---	-------------------	----	----	-----	-----	--

19.16a

	ADH	ADL	N	CMD <sub>81</sub>	NN <sub>00</sub>	CRH	CRL	
--	-----	-----	---	-------------------	------------------	-----	-----	--

19.16b

	ADH	ADL	N	CMD <sub>84-87</sub>	NN <sub>00</sub>	CRH	CRL	
--	-----	-----	---	----------------------	------------------	-----	-----	--

19.16c

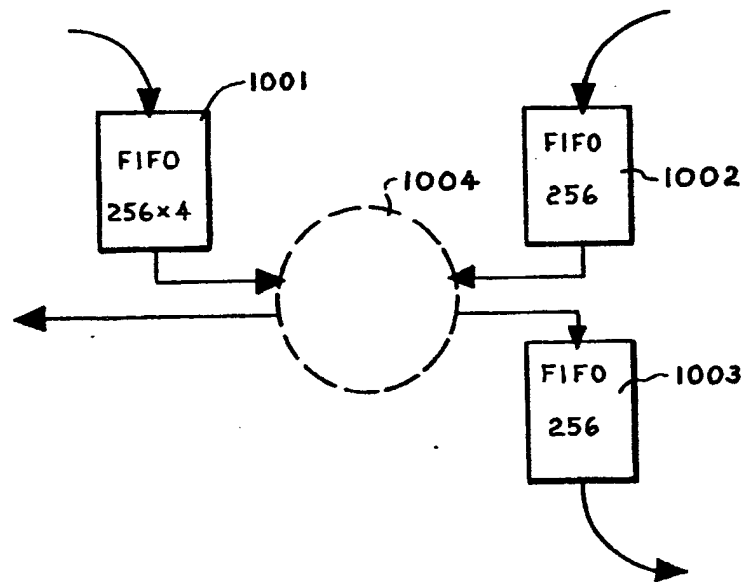
	ADH	ADL	N	CMD <sub>88</sub>	NN	PN	CRH	CRL	
--	-----	-----	---	-------------------	----	----	-----	-----	--

19.17

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*Fig. 1B a*

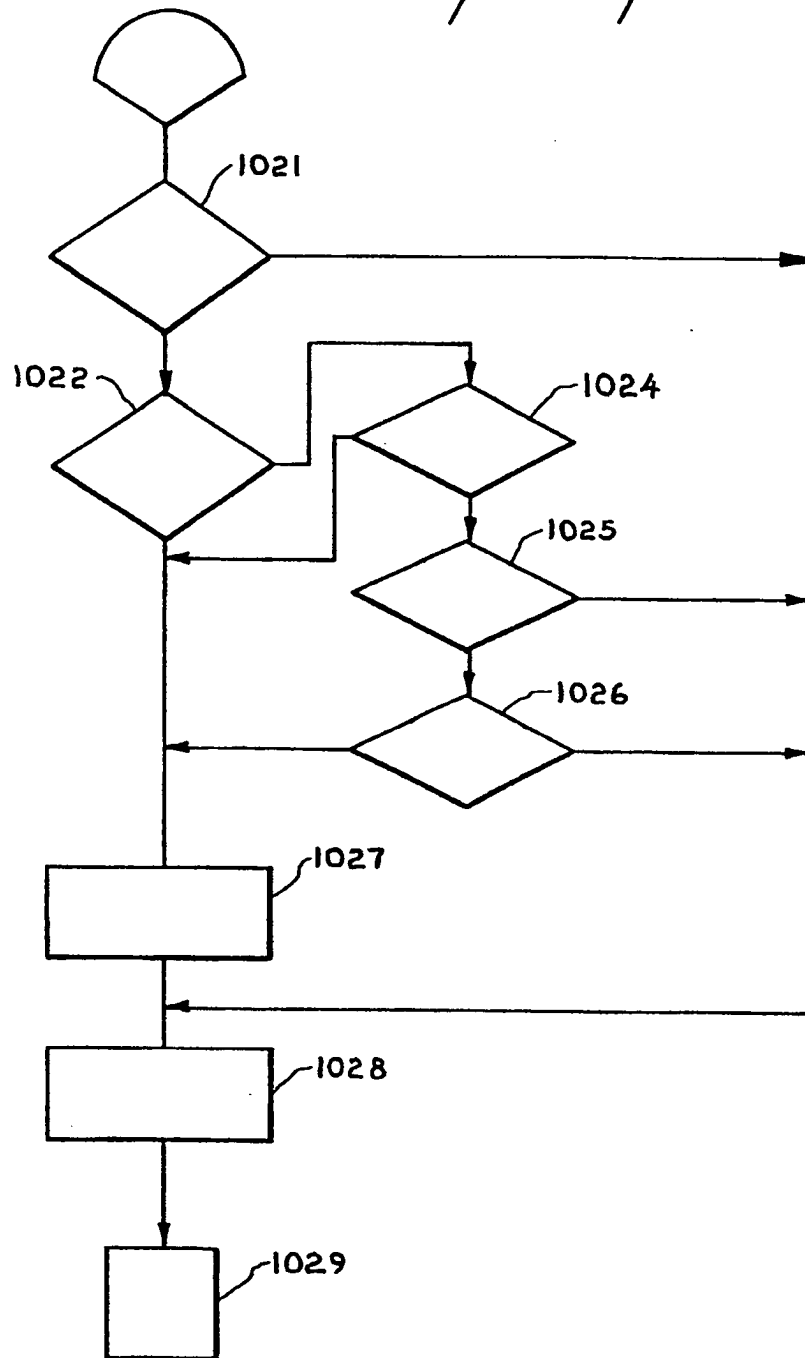




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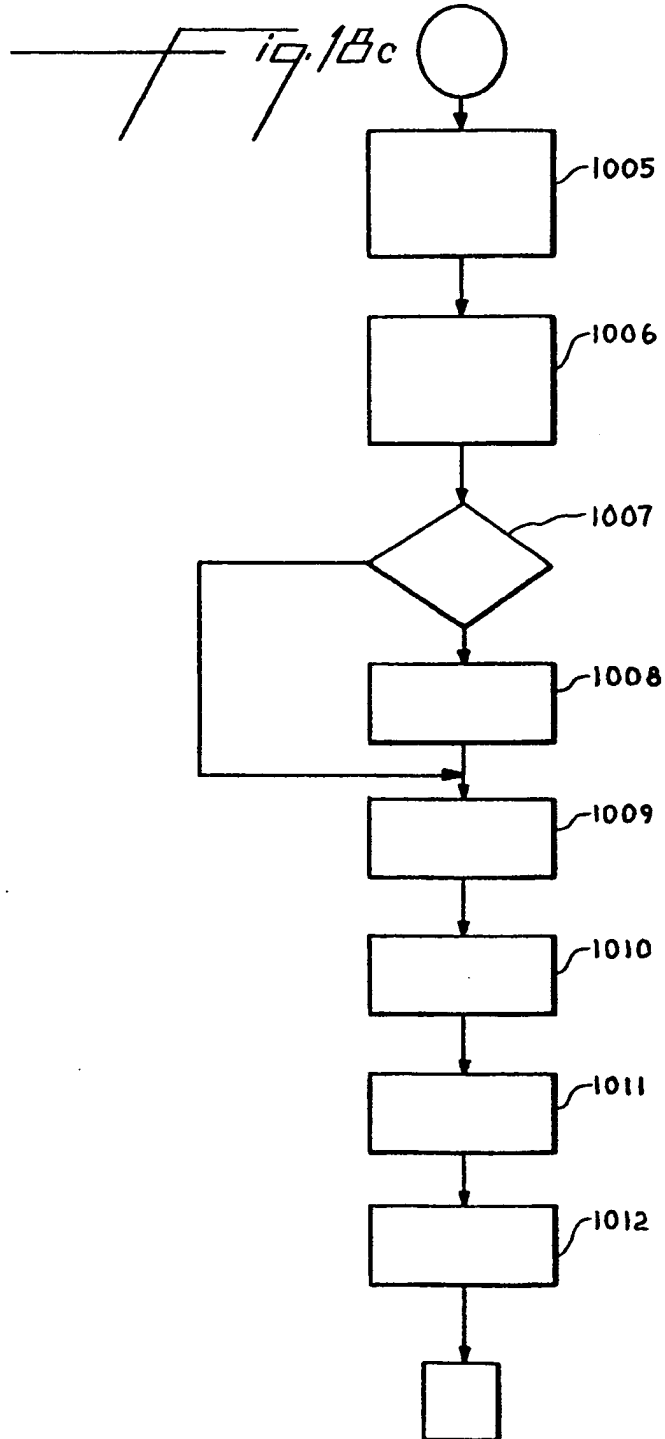
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*ig. 1a*



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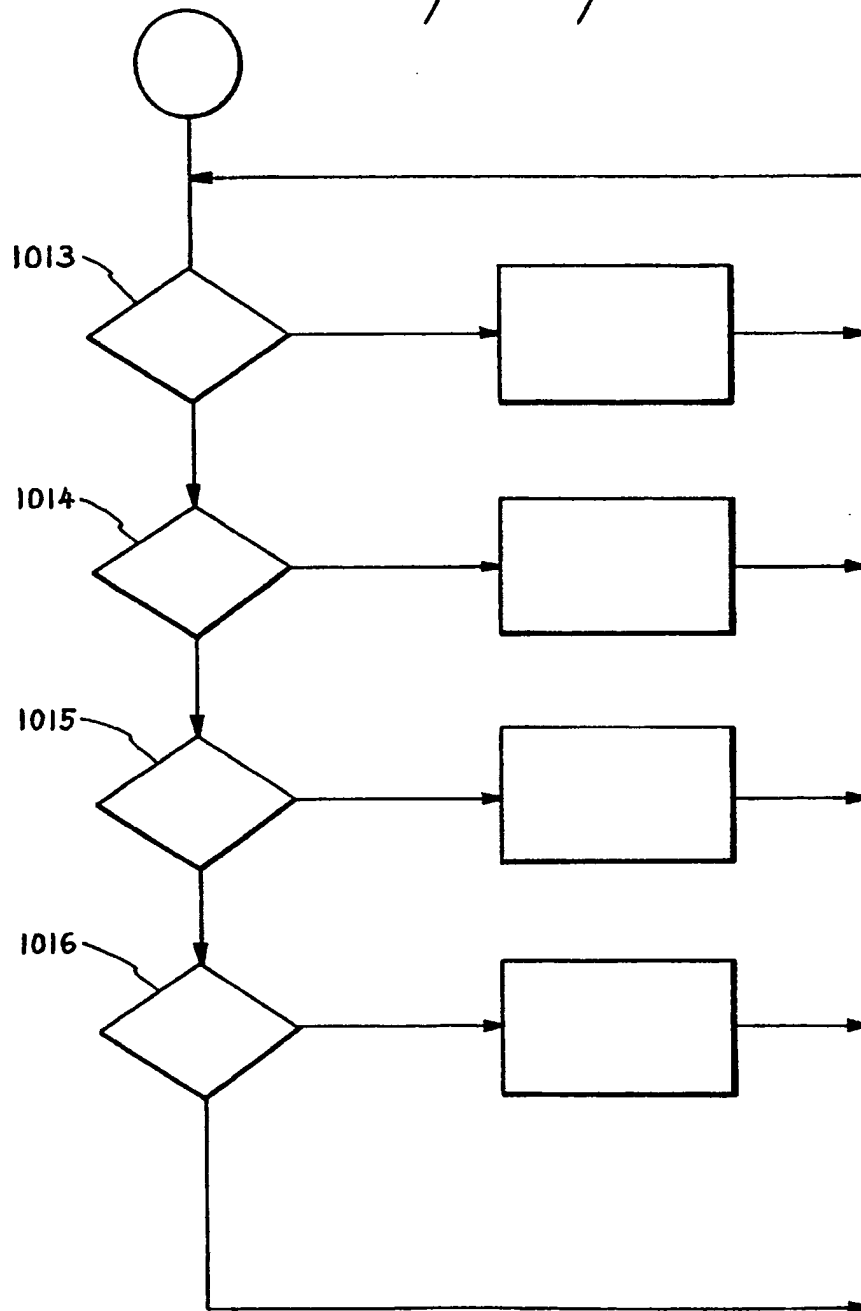
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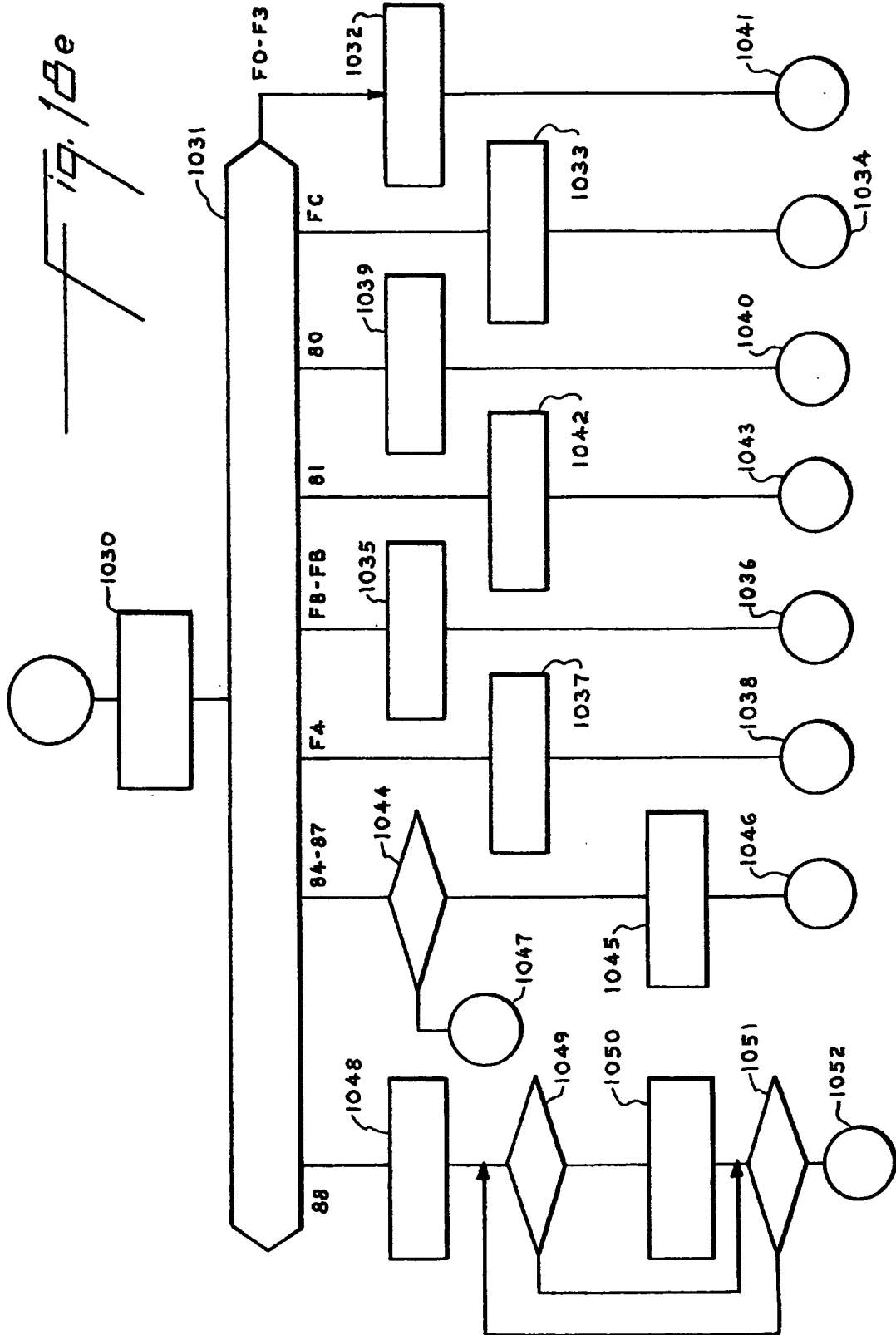
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*ig. / Bd*



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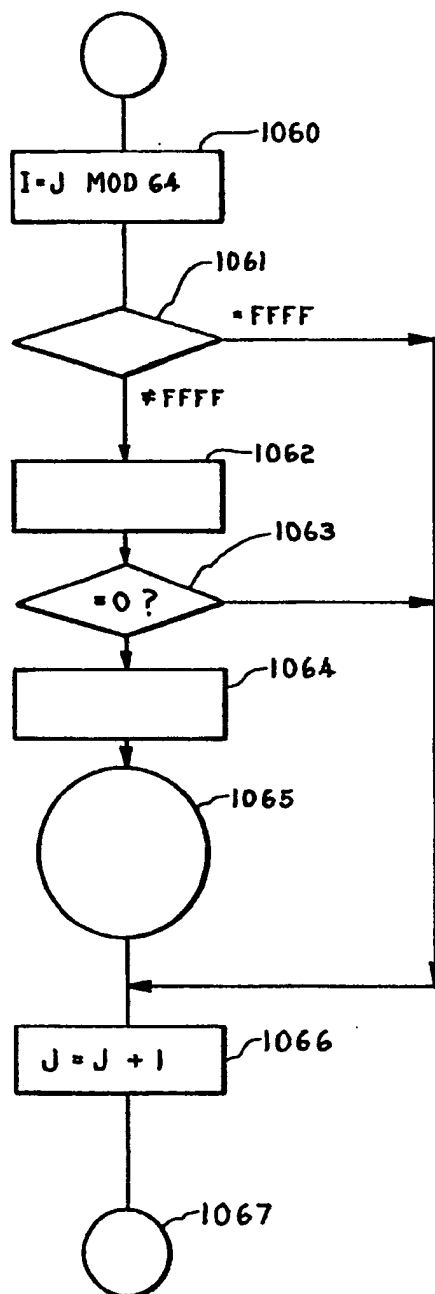
19.13e

24.3

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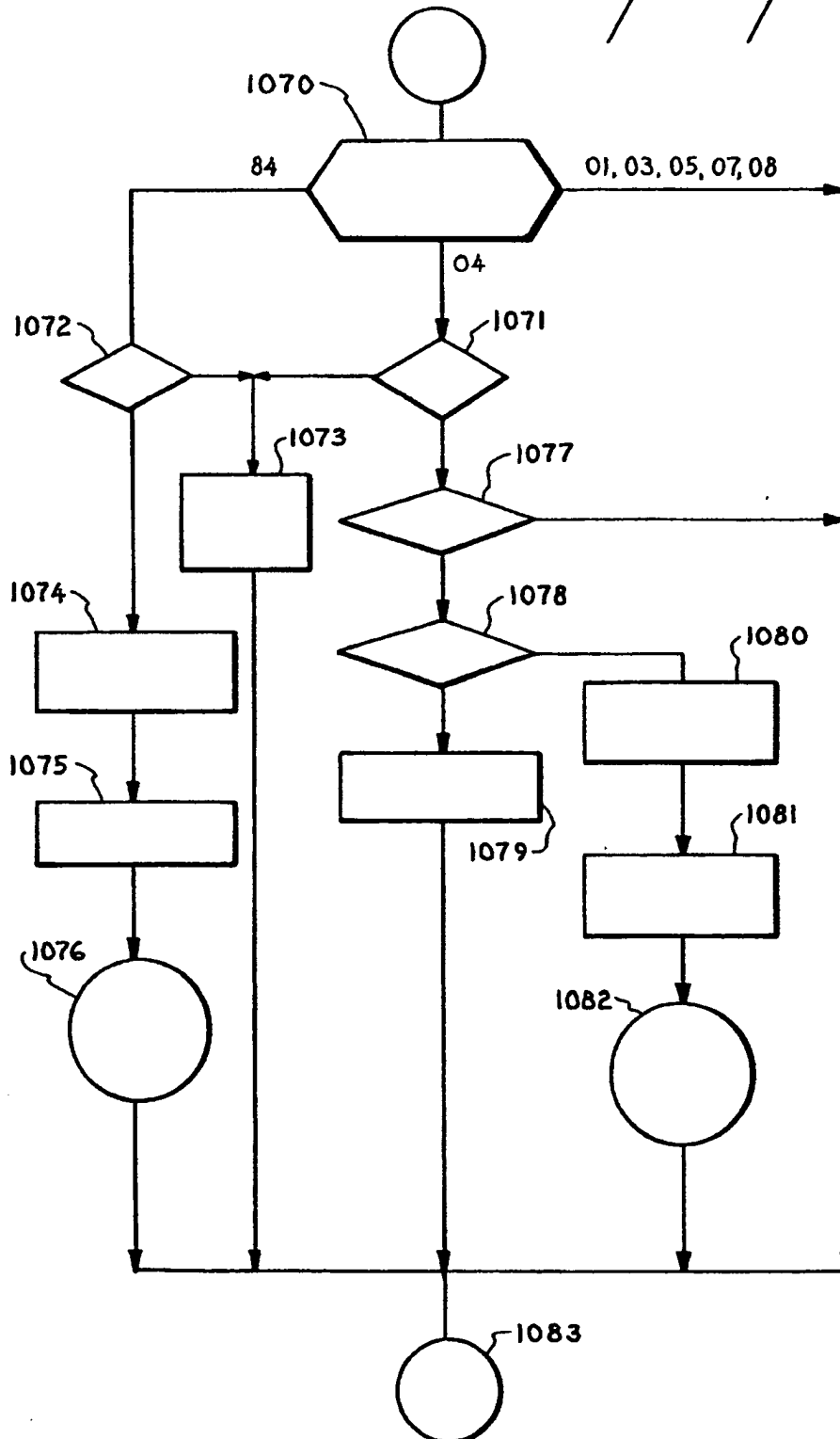
*ig. 1Bf*



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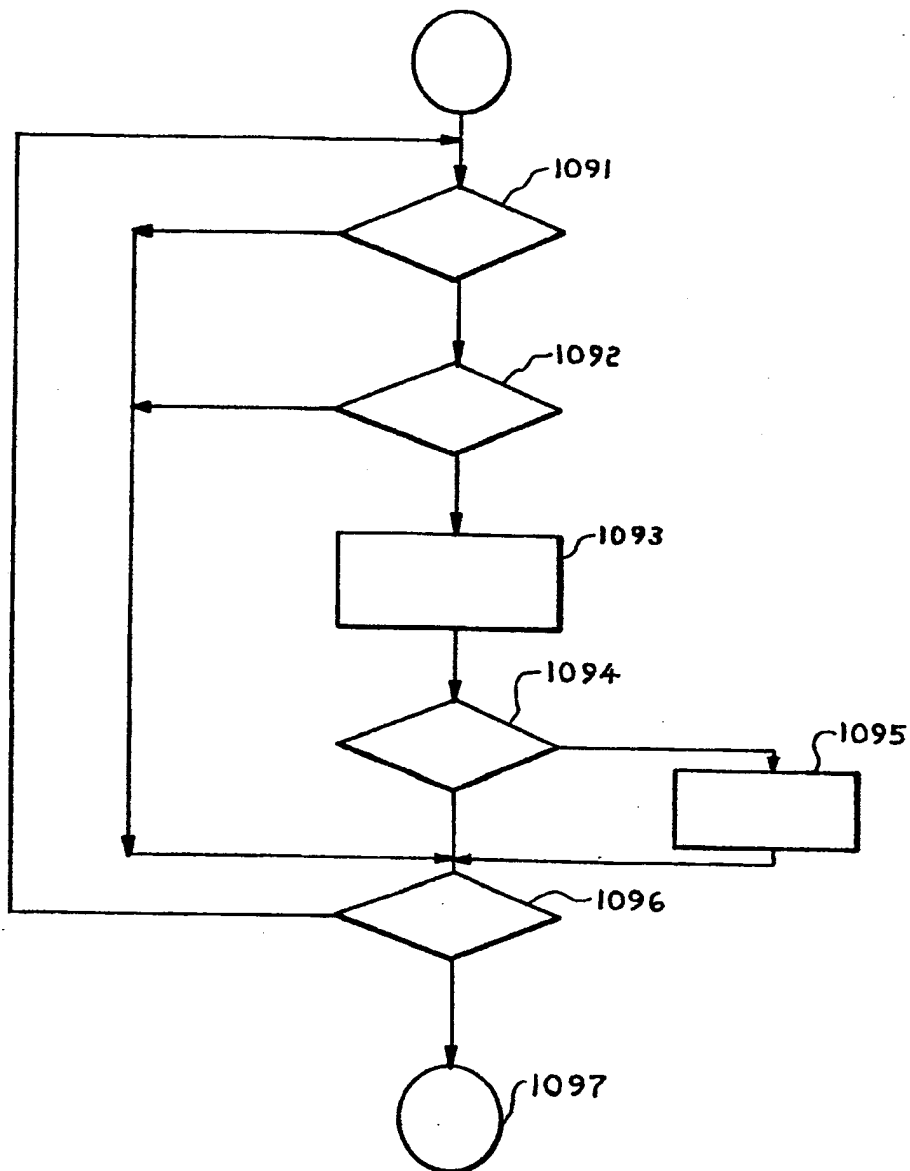
*Fig. 1B g*



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Fig. 1Bh







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19. 2/a

		CTL	LVL	CRH	CRL	
--	--	-----	-----	-----	-----	--

19. 2/b

		ADL	ADH	CRH	CRL	
--	--	-----	-----	-----	-----	--

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19. 22a

		CTL	LVL	CRH	CRL
--	--	-----	-----	-----	-----

19. 22b

		ADL	ADH	CRH	CRL
--	--	-----	-----	-----	-----

19. 22c

		LVL	CTL	D <sub>n</sub> (1-6 BYTES)	CRH	CRL
--	--	-----	-----	-------------------------------	-----	-----

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		BSHAL	BSHAH	BSLAL	BSLAH	CRH	CRL		<u>19</u> 23a
--	--	-------	-------	-------	-------	-----	-----	--	---------------

		BSHAL	BSHAH	BSLAL	BSLAH	CRH	CRL		<u>19</u> 23b
--	--	-------	-------	-------	-------	-----	-----	--	---------------

		BSLAL	BSLAH	CRH	CRL				<u>19</u> 23c
--	--	-------	-------	-----	-----	--	--	--	---------------

		BSHAL	BSHAH	CRH	CRL				<u>19</u> 23d
--	--	-------	-------	-----	-----	--	--	--	---------------